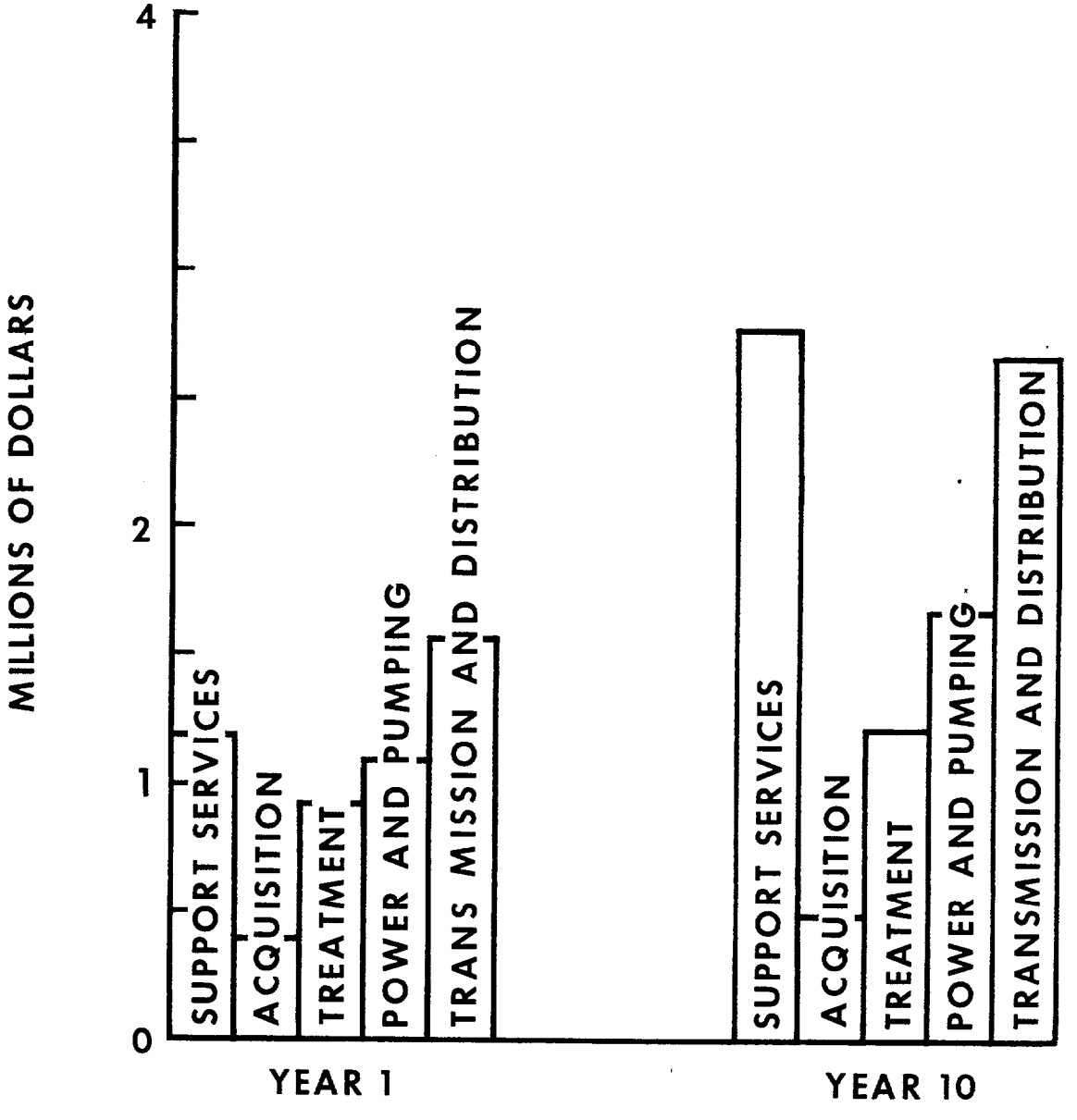


FIG. 14 OPERATING COSTS FOR CINCINNATI WATER WORKS

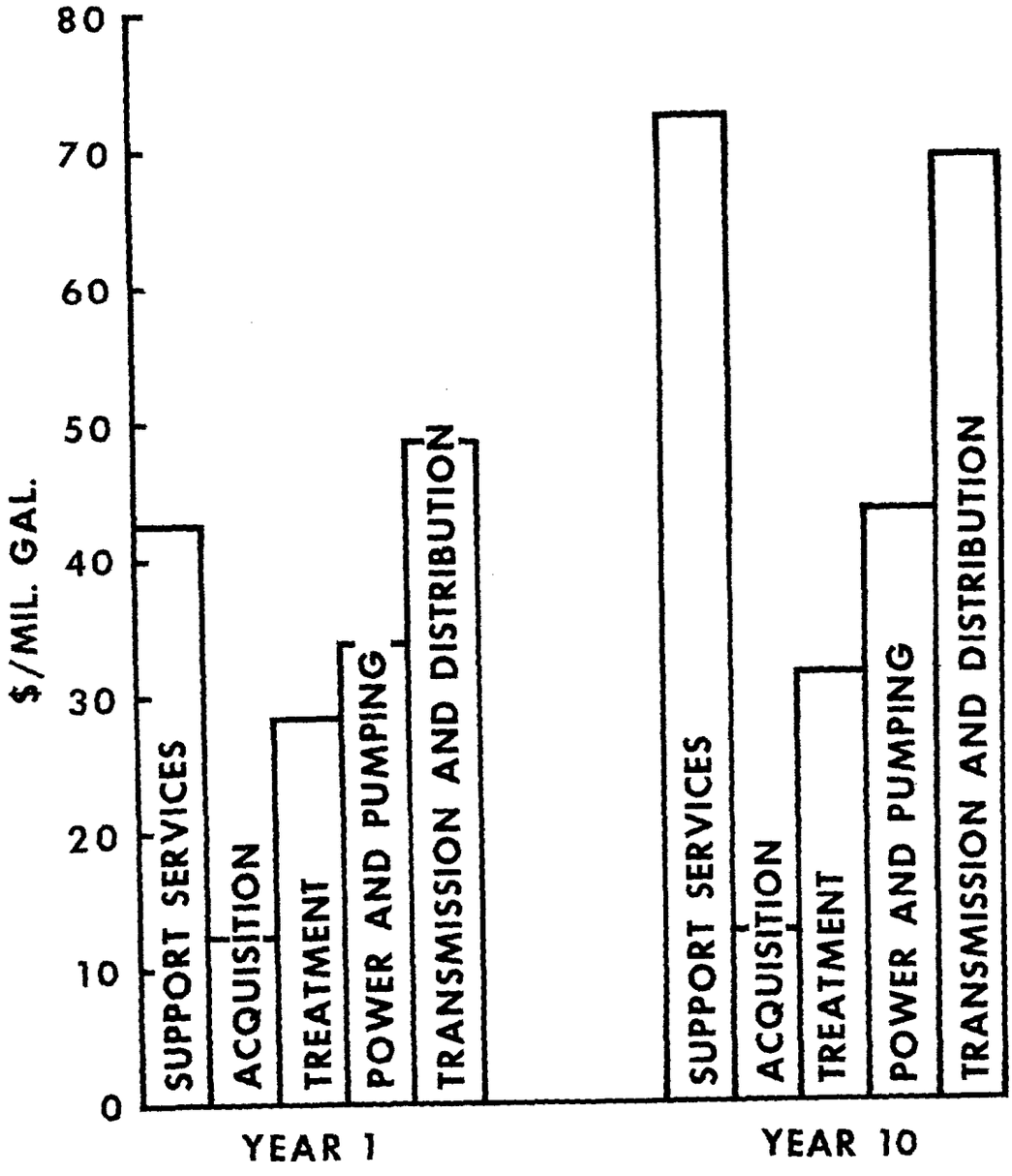


FIG. 15 OPERATING COSTS $/MIL. GAL. FOR CINCINNATI WATER UTILITY

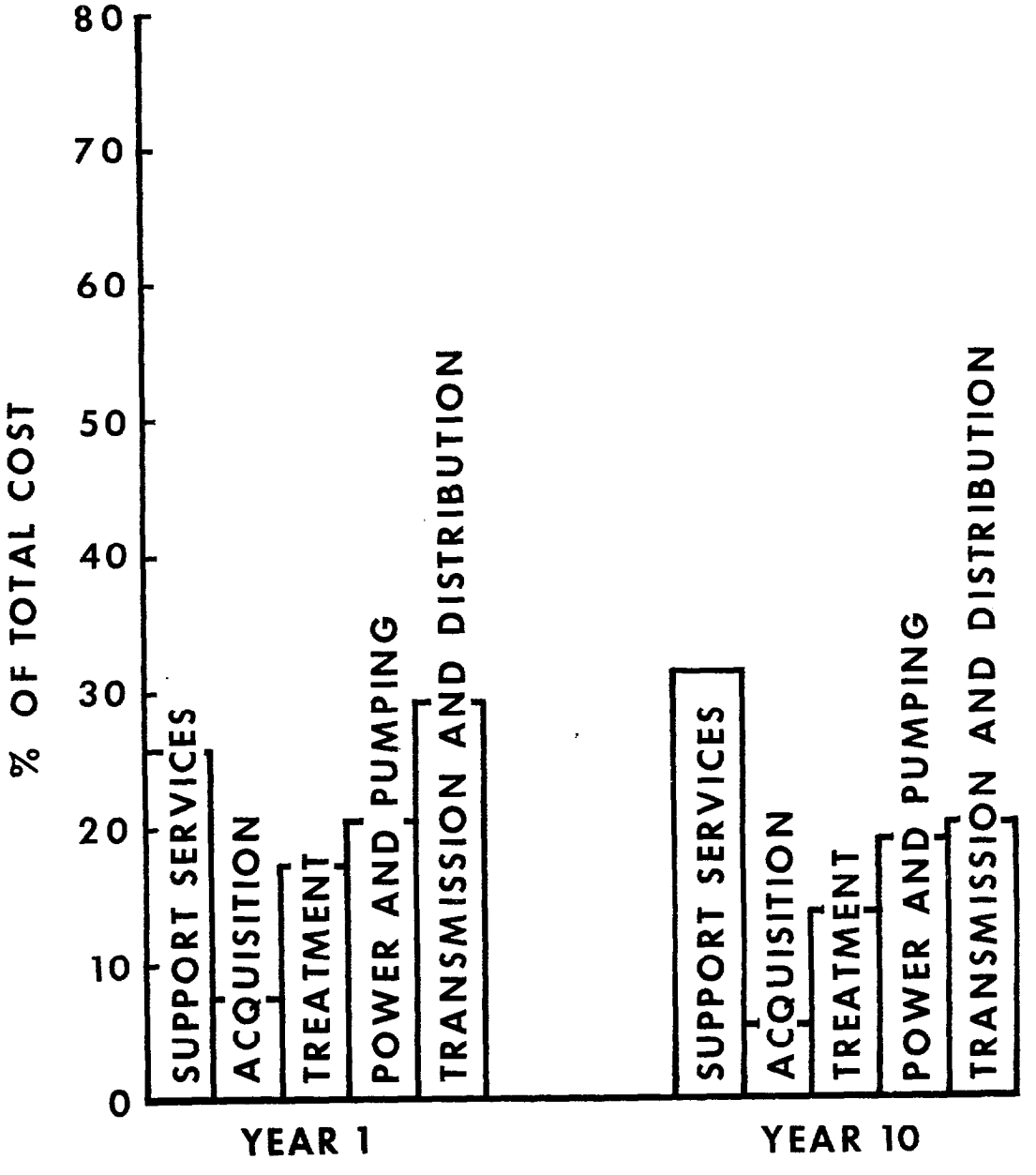


FIG. 16 OPERATING COST AS PERCENT OF TOTAL COST FOR CINCINNATI WATER UTILITY

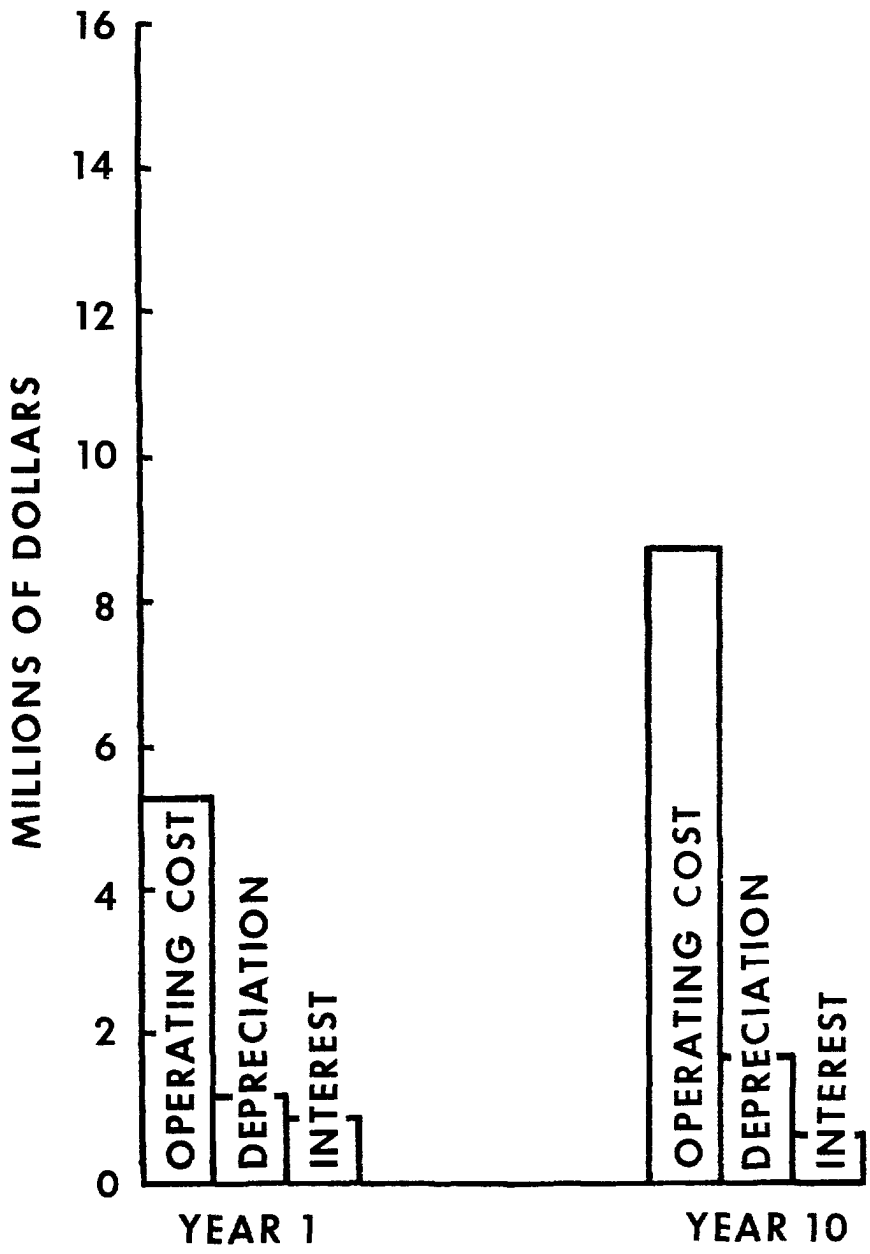


FIG. 17 OPERATING AND CAPITAL COSTS FOR CINCINNATI WATER WORKS

Figure 18 depicts the expenditures for capital and operations and maintenance over the 10-year period. Figure 19 shows the total expenditures (historical and corrected) over the period of analysis. The corrected values have been computed using the CPI, assuming 1965 as the base year. On a corrected basis, expenditures remained constant. Figure 20 shows the actual and corrected expenditures, based on time. Figure 20 shows that the unit cost of water supply (corrected) has actually decreased in Cincinnati.

Operating expenditures are always reported in inflated or current dollars, whereas capital expenditures are depreciated in historical dollars over a long period of time. Problems related to the depreciation of capital will be discussed later. Since the support services category, which is labor intensive, plays an important role in the cost of water supply, labor and manpower costs will be analyzed in the following section.

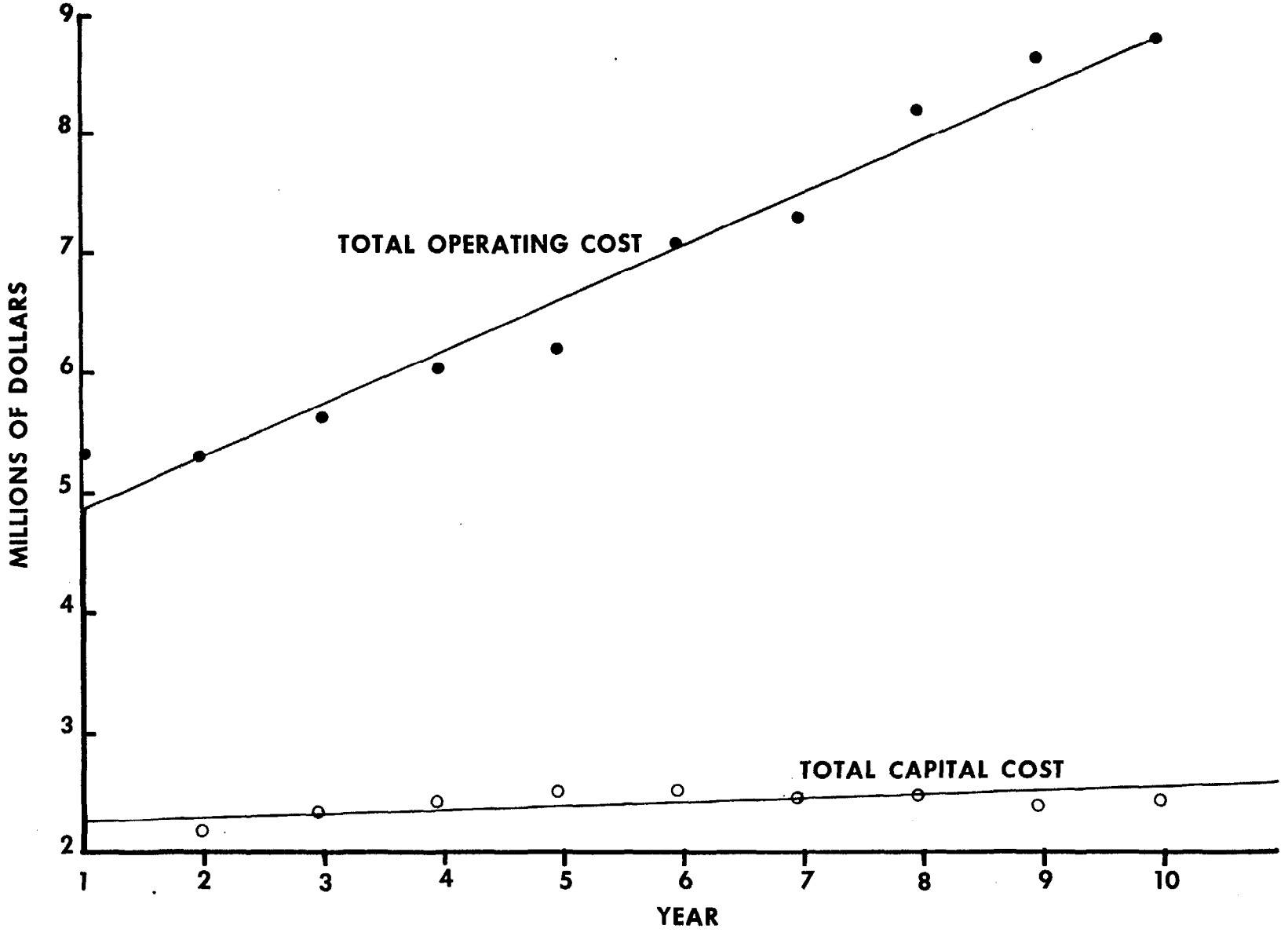
Labor Cost Analysis --

One means of evaluating the impact of labor costs on operation costs for water supply is to examine the payroll of the water utility (Table 7). Labor costs accounted for 64% of the utility's operating costs in year 1, and the number of man-hours/mil gal of metered consumption decreased by 23%. The bottom line in the table shows a decreasing capital/labor cost ratio. Although economies of scale were achieved with respect to the number of man-hours used to produce water, the effect on cost was nullified by wage increases. The table therefore illustrates the importance of labor in what is typically presumed to be a capital intensive industry.

Depreciation Analysis --

As mentioned earlier, capital expenditures make up a large portion of the cost of water supply. Depreciation reflects historical costs and not the current cost of replacing a capital facility. Historical costs refer to the original construction cost of a capital facility, whereas reproduction costs reflect the capital expenditures necessary to build an identical plant today. Historical cost is exact, but reproduction cost is based on the original investment modified by an appropriate index. A comparison between historical and reproduction costs indicates the impact of inflation.

Using historical costs, a reproduction cost was calculated using the Engineering News Record (ENR) Building Cost Index (1913 = 100) for buildings and equipment and the ENR Construction Cost Index (1903 = 100) for pipes and valves.[10] (A skilled labor cost factor is used to compute the Building Cost Index, and a common labor cost factor is used to compute the Construction Cost Index.) After weighing these capital expenditures with the proper indices, a reproduction cost of $459 million was found for the current plant-in-service, which represents a 311% increase over the historical value. These capital expenditures do not include the capital investment in a new treatment plant (Great Miami), which is operational. Derivation of a reproduction value illustrates the impact of inflation on capital cost and the current worth of capital's contribution to output. The computations discussed in this section are summarized in Table 8.



FIG, 18 OPERATING AND CAPITAL EXPENDITURES FOR CINCINNATI WATER WORKS

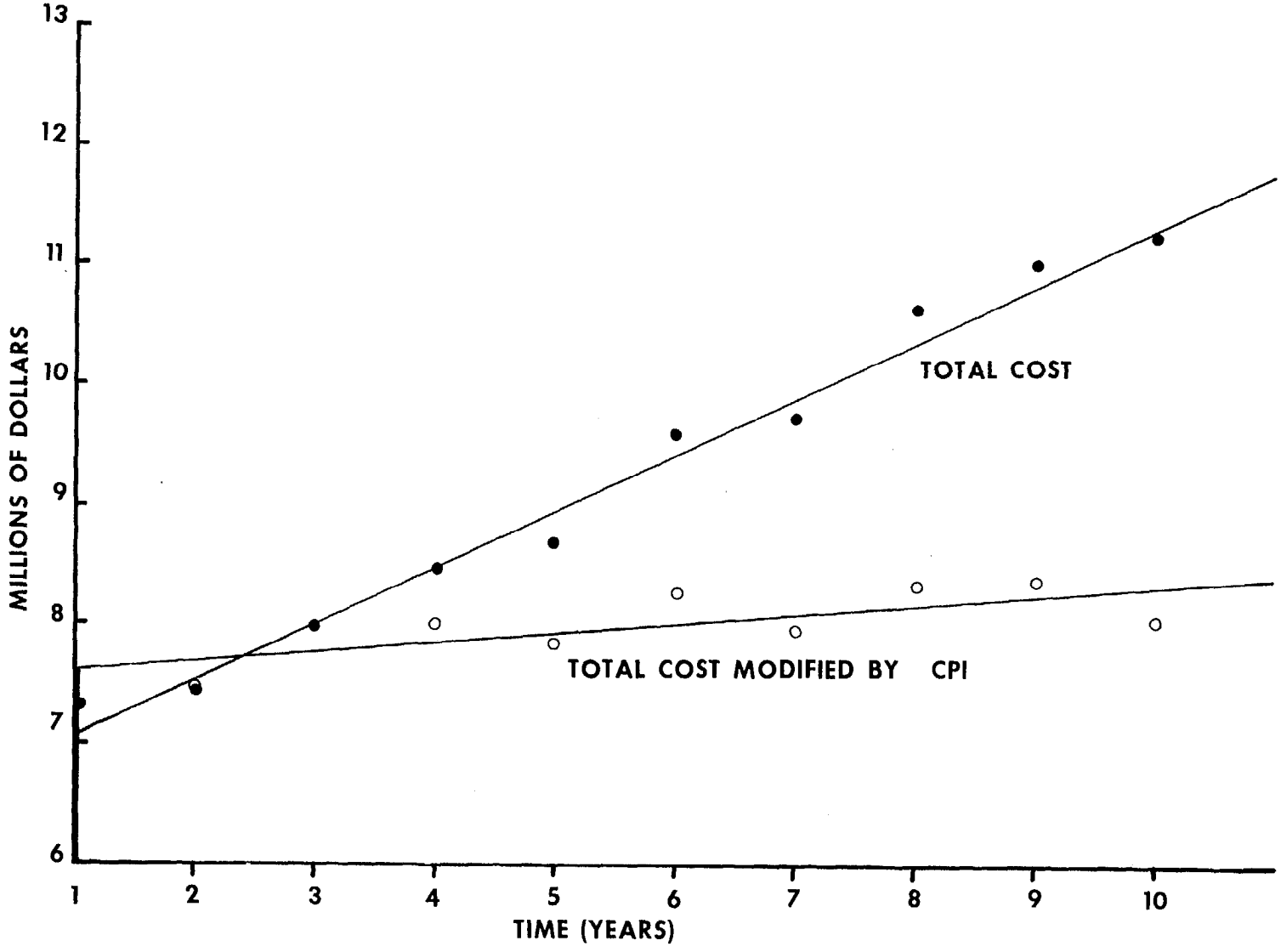


FIG. 19 TOTAL EXPENDITURES VERSUS TIME FOR CINCINNATI WATER WORKS: HISTORICAL AND MODIFIED

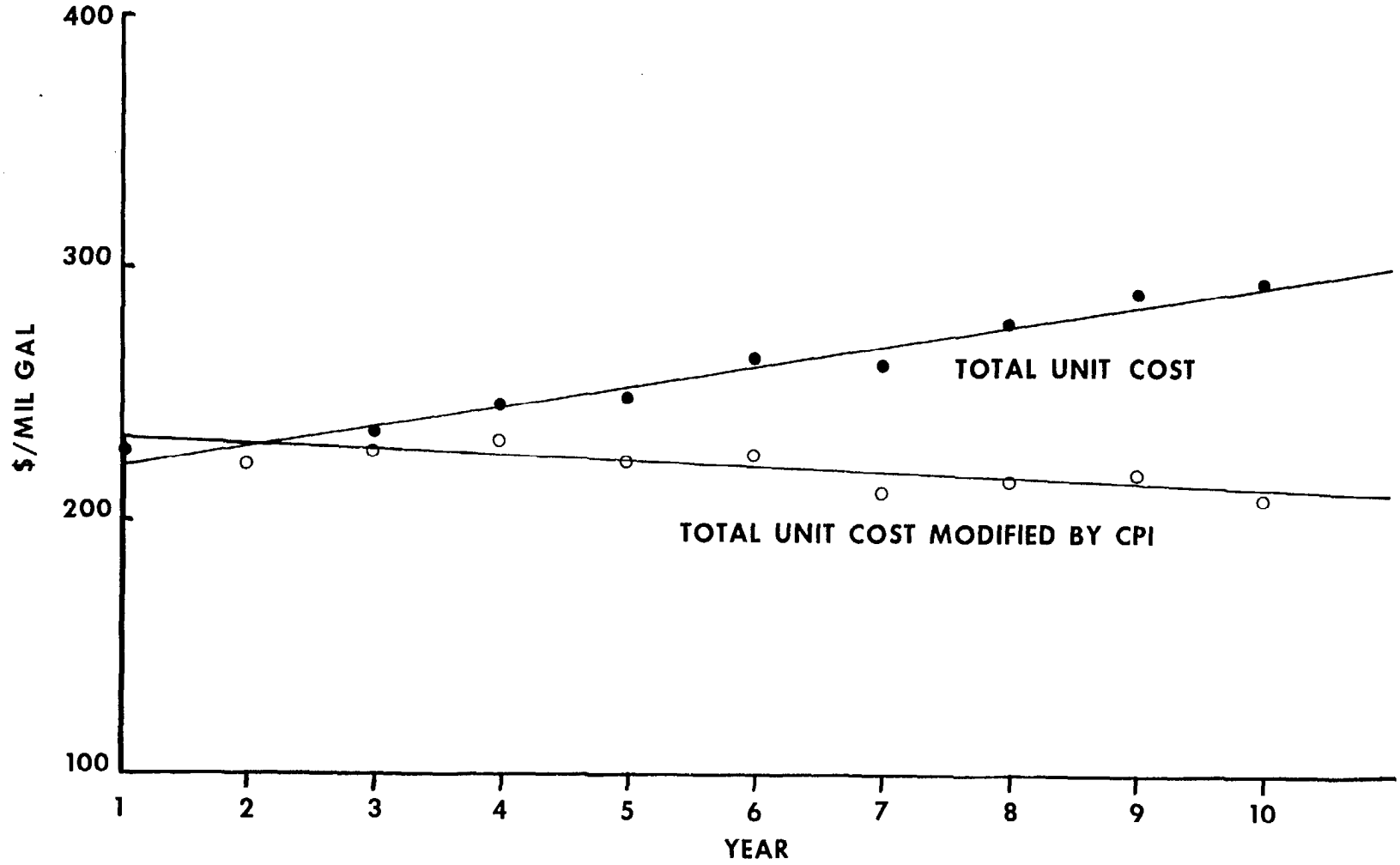


FIG. 20 UNIT COSTS FOR CINCINNATI WATER WORKS: HISTORICAL AND MODIFIED

TABLE 7. MANPOWER COSTS FOR CINCINNATI WATER WORKS

Item	Year 1	2	3	4	5	6	7	8	9	10
Total payroll ($)	3,393,575	3,399,082	3,664,567	3,946,864	4,085,948	4,446,863	4,467,360	4,979,657	5,261,055	5,474,585
Total hours on payroll	1,110,032	1,116,220	1,102,892	1,120,980	1,148,588	1,141,448	1,115,744	1,094,229	1,071,476	1,046,824
Metered consumption (mil gal)	32,063	33,061	33,725	34,160	34,722	36,199	37,117	38,128	37,928	38,104
Total payroll ($/mil gal)	105.84	102.81	108.66	115.54	117.68	122.84	120.36	130.60	138.71	143.68
Total hours/ mil gal	34.62	33.76	32.70	32.81	33.08	31.53	30.06	28.70	28.25	27.47
Average cost/ man hour	3.06	3.04	3.32	3.52	3.56	3.89	4.00	4.55	4.91	5.23
Capital/labor cost ratio	0.60	0.64	0.64	0.61	0.61	0.57	0.54	0.49	0.46	0.45

TABLE 8. HISTORICAL AND REPRODUCTION COSTS OF PLANT-IN-SERVICE FOR CINCINNATI WATER WORKS

Capital facility	Historical cost	Reproduction cost (1974 dollars)
Plant	$ 42,649,160	$ 146,981,272
Pipe	54,848,943	296,771,626
Misc, plant*	14,202,213	15,237,389
Total	111,700,315	458,990,286

* Capital expenditures that are not specifically identified.

System Evaluation

Using the cost data for the various functional areas discussed earlier, costs were allocated to specific treatment, transmission, storage, and pumping facilities in the system (Figure 21). A general cost was determined for distribution, interest, and overhead.

The facilities in the schematic diagram (Figure 21) can be related to cost zones, as in Kansas City. For example, the acquisition cost of water from the Ohio River, including depreciation of the facility and operating costs, is $16.70/mil gal. As a unit of water (mil gal) moves through one facility to another, the unit cost of moving water through the first is added to the cost of getting water to the second, thereby creating incremental costs. The facility and transmission costs are added to the costs of distribution, interest, and overhead to yield an average unit cost to serve that area. A service zone represents a customer service area and a demand point for water. For purposes of the distribution cost analysis, an attempt was made to discriminate between the water demanded in a given distribution area and the water transmitted through the area into the next service zone.

To illustrate how cost changes from one service area to another, we can examine the B1 and B2 cost areas (Figure 22). The cost/mil gal for area B1 is composed of acquisition cost ($16.70), treatment cost ($60.26), distribution cost ($50.52), interest cost ($17.57), and overhead cost ($85.22). This yields a total cost of $336.86/mil gal. For the B2 area, the pumping and storage costs ($80.45) and the transmission costs ($60.26) must be added to the B1 costs, which yield $477.60/mil gal. These values are plotted in Figure 23. The costs in each zone are described by a step function. The cost of water pumped from the treatment plant through the B1 is assumed constant; however, as water is repumped into the B2 zone, the costs take a definable jump, yielding a step function.

The step function suggests the possibility that as additional service zones are added to the periphery of the utility service area, the cost functions will continually increase. A comparison of this cost analysis to the prices actually charged in the utility service area is useful. Figure 24 shows all of the cost zones listed in Figure 21 that make up the Cincinnati Water Works service area. Table 9 compares revenues received from the 10 largest users in the service area and the actual cost of service.

The cost column was calculated as shown in Figure 22. Adjusted cost was figured by allocating support services on a service per customer basis. Table 9 shows that in many cases, the major users have not met the cost of supplying water to them.

DALLAS WATER UTILITY

The Dallas Water Utility serves the city of Dallas, which lies within Dallas County in north central Texas.[7] The city has a population of 942,467, and the county's population is 1.5 million, based on the 1970 census. Dallas' annual growth rate of 3.1% has many implications for urban services

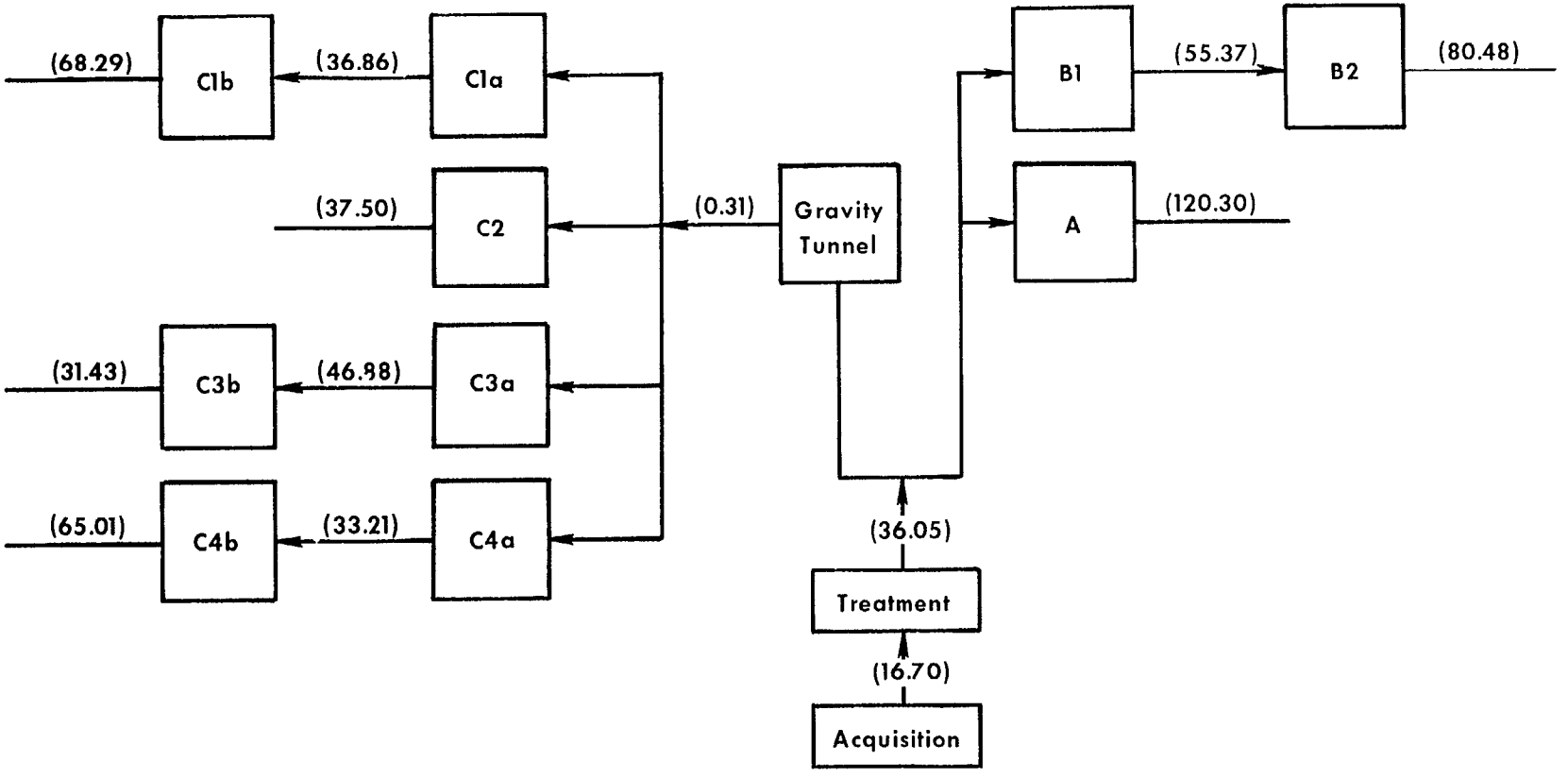


FIG. 21 SCHEMATIC DIAGRAM OF FACILITY COSTS IN CINCINNATI WATER WORKS SYSTEM. *

*** (COSTS IN $/MIL GAL OF REVENUE PRODUCING WATER)**

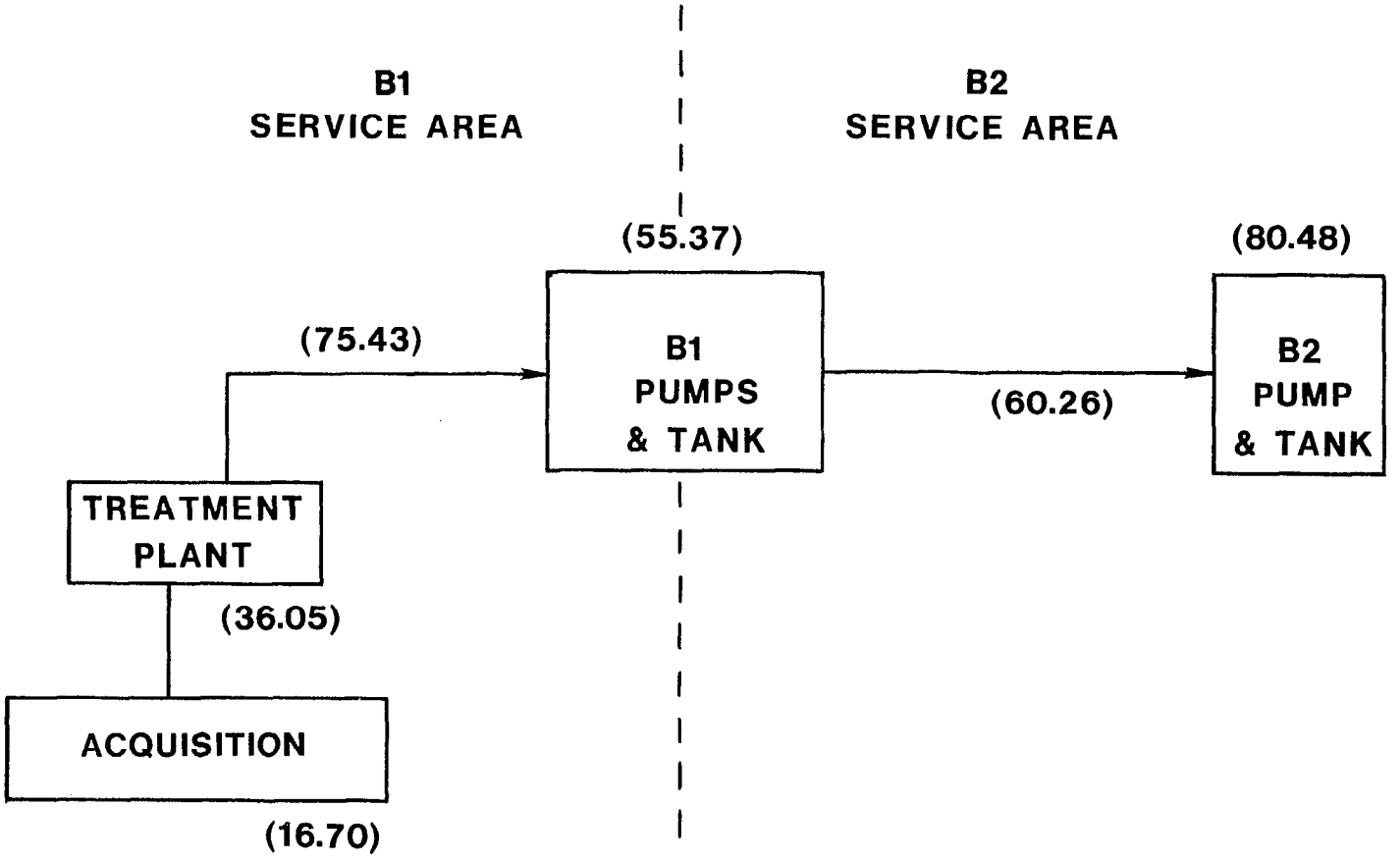


FIG. 22 SCHEMATIC DIAGRAM OF INCREMENTAL COSTS FOR B1 AND B2 SERVICE AREAS *

*(COST IN $/MIL GAL OF REVENUE PRODUCING WATER)

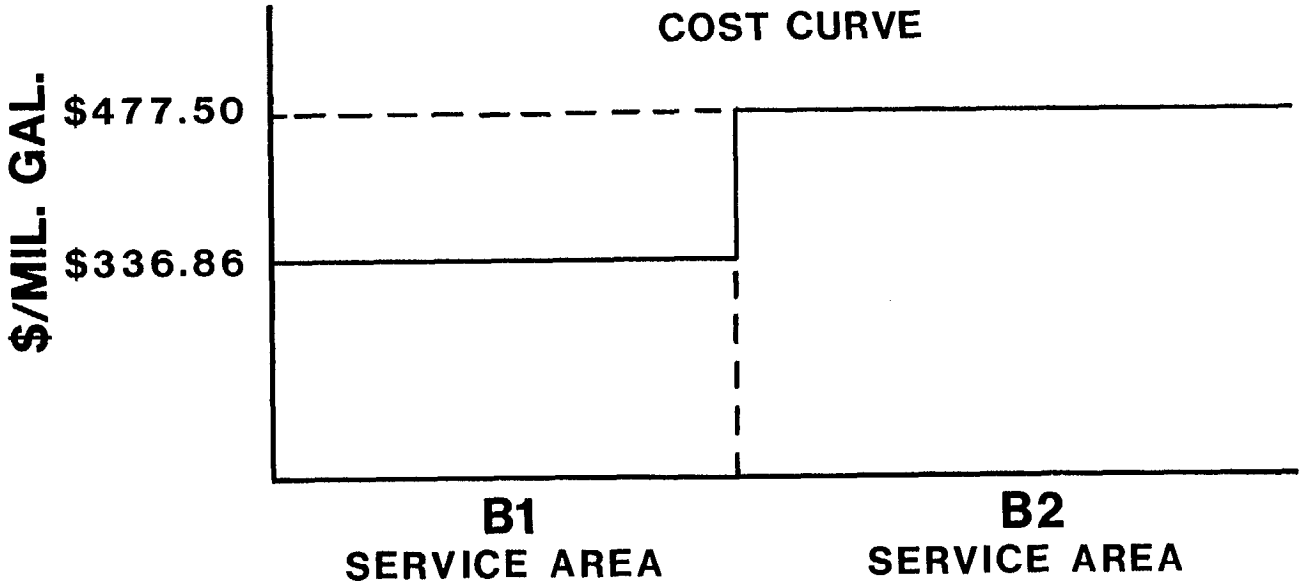


FIG. 23 Step function cost curve for B1 and B2 service areas.

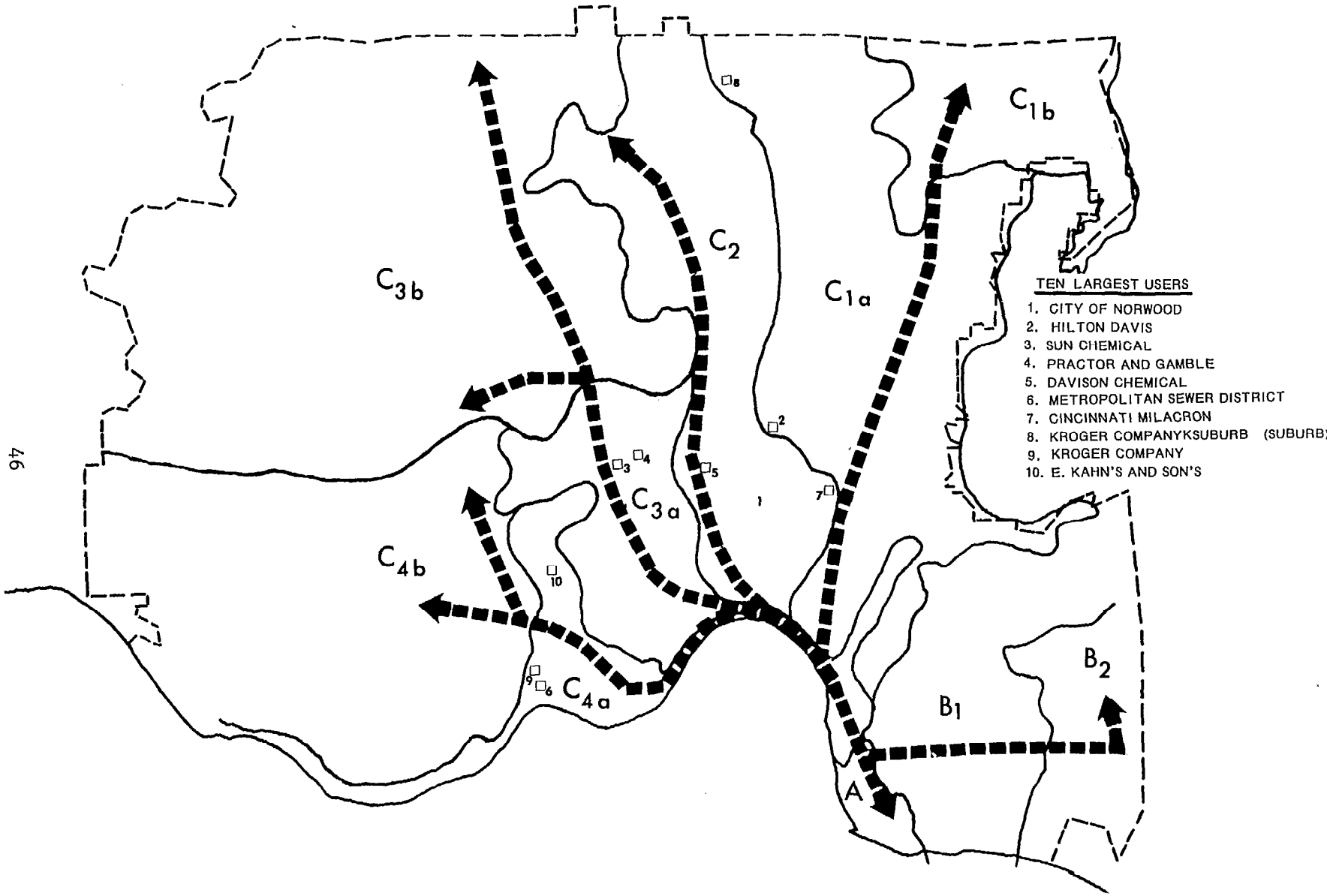


FIG. 24 MAJOR USERS IN CINCINNATI WATER WORKS SERVICE AREA

TABLE 9. ACTUAL CHARGE VERSUS REAL COST FOR TEN MAJOR USERS IN CINCINNATI WATER WORKS

($/mil gal)

User	Revenue*	Cost+	Adjusted cost+
Norwood	$ 294.12	$ 272.80	$ 243.52
Hilton Davis	168.83 175.67	262.99	233.71
Sun Chemical	169.87 175.44	275.54	246.26
Procter & Gamble	308.70 321.12	275.54	246.26
Davison Chemical	87.54 180.26	272.80	243.57
Metropolitan Sewer	175.19 185.44	264.56	235.28
Cincinnati Milacron	175.07 187.95	272.80	243.52
Kroger Company (Suburb)‡	313.54 328.26	262.99	233.71
Kroger Company	181.90 197.73	264.56	235.28
E. Kahn's Sons	181.67 195.17	264.56	235.28

* Wherever two values are presented, one represents the high and the other the low bill in $/mil gal for 1973-74.

+ These values were calculated on an average cost basis and as such do not reflect potential economies of scale that result from having large users in the system.

‡ Suburban users are charged at a higher rate to allow for expansion into Hamilton County.

such as water supply. The Dallas Water Utility provides water on a retail basis to all classes of customers within the city of Dallas, and provides wholesale water to 16 other communities within the county.

Organizationally, the Dallas Water Utility combines both water supply and wastewater treatment functions. It is composed of three sections: engineering and planning, operations, and business.

Raw water comes from five major reservoirs and is treated in three separate treatment plants in the northwest, central, and southeastern sections of the city. The treatment plants are generally located in the low-lying areas of the city, thus requiring that water be pumped up to residences and businesses at higher elevations.

The placement of the treatment plants represents an interesting example of decentralization to minimize the cost of delivering water to the consumer. Figure 25 shows the locations of plants and pumping facilities relative to the service area. The Elm Fork, Bachman, and East Side treatment plants ring the service area, thereby reducing the incremental cost of supplying water to the service area.

Figure 26 illustrates the substantial growth in consumer demand for water over the 10-year period of analysis.

Cost Analysis

Operating costs were categorized as follows: acquisition, treatment, transmission and distribution, power and pumping, and support services. Table 10 summarizes the historic costs in these areas for the study period. During these 10 years, the actual accounting system changed three times, making it difficult to track some of the specific cost items.

Table 10 shows that the total operating cost of water has increased from $5.7 million to $12.5 million (see also Figure 27). The cost of support services has increased at a faster rate, from $1.4 million to $4.7 million. On a unit basis, the total operating cost of water supply has increased from $144.80/mil gal to $198.76/mil gal, with the greatest increase occurring in support services -- from $34.51/mil gal to $74.57/mil gal in 1973-74 (Figure 28). Table 10 also shows each operating cost category as a percent of total operating cost, thus making it possible to identify where shifts have occurred in the proportion of money committed to a given task. Figure 29 gives a graphic representation of these shifts.

The unit operating cost in Dallas has not increased as fast as total cost over the 10-year period. Also, the cost/mil gal fluctuates based on the actual amount of water required in any given year. This fluctuation results from the ability of a given work force to produce a variable amount of water. Thus, if the demand is heavier during the year because of an unusual drought, water consumption will be higher without a proportional increase in cost. The reverse is also true. If the water usage is low because of unusual

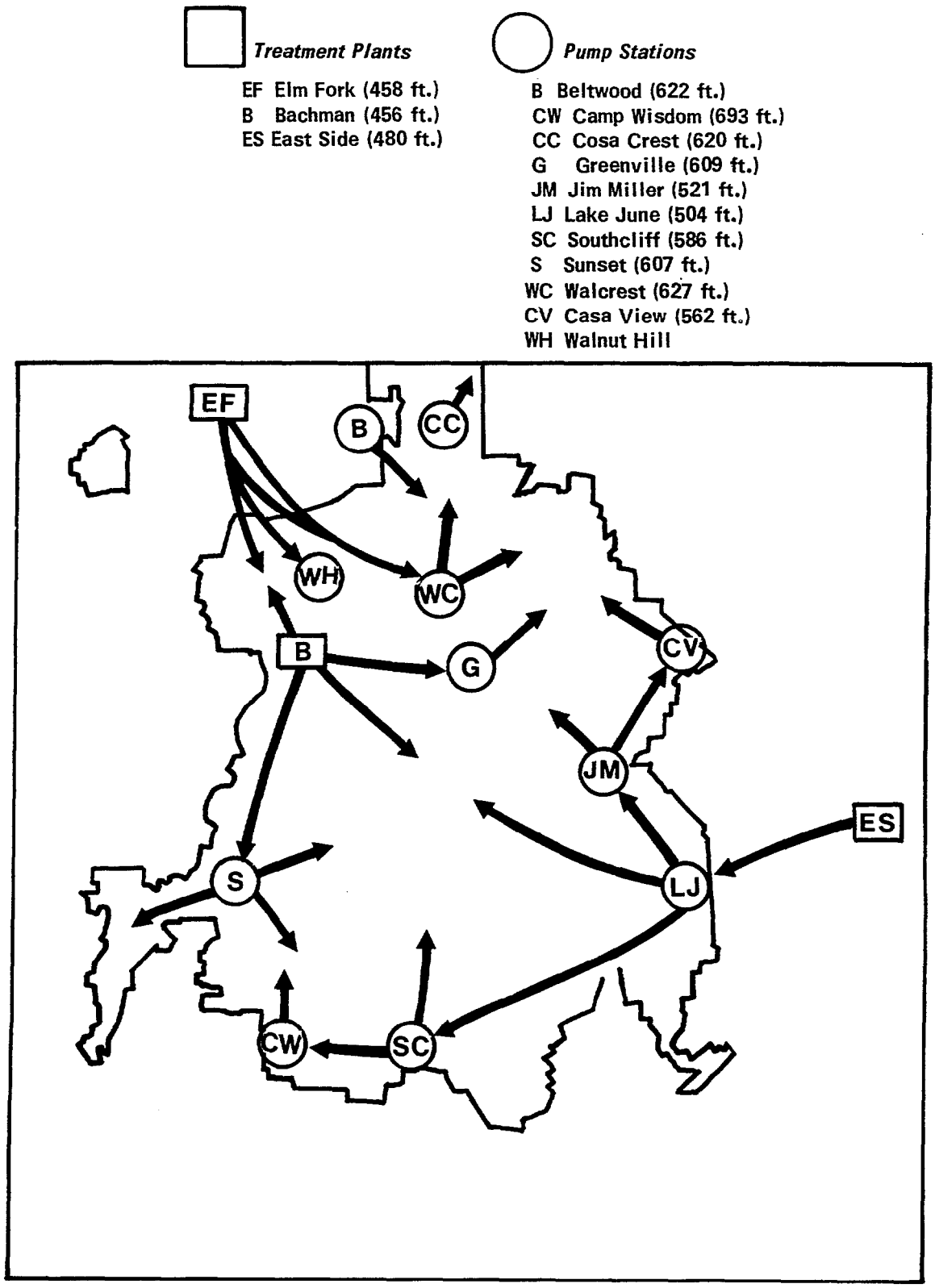


FIG. 25 TREATMENT PLANTS AND PUMP STATIONS IN DALLAS UTILITIES SERVICE AREA

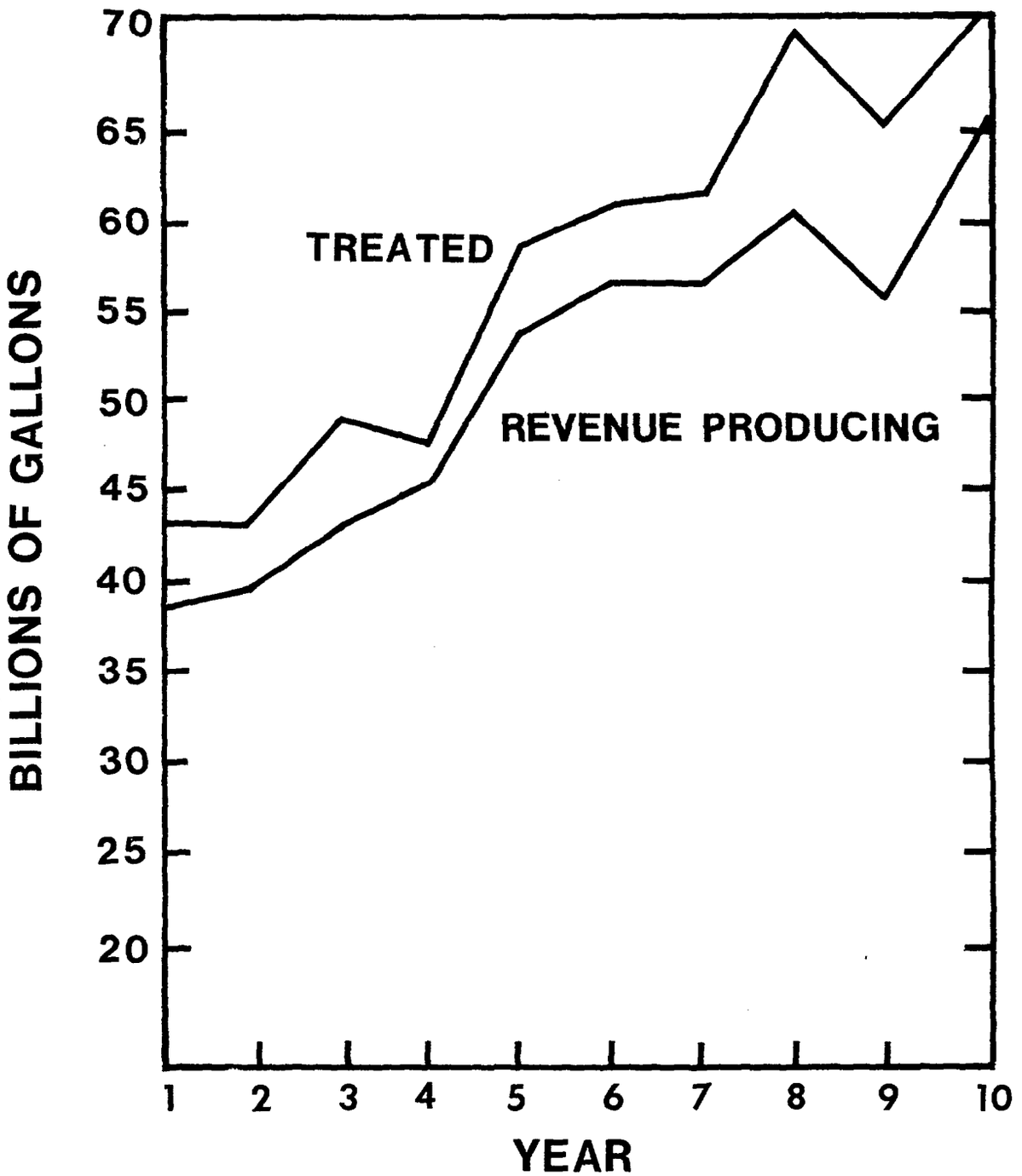


FIG. 26 TREATED AND REVENUE PRODUCING WATER FOR DALLAS WATER UTILITY

TABLE 10. SUMMARY OF OPERATING AND CAPITAL EXPENDITURES FOR 1965-74 FOR DALLAS WATER UTILITY

Item	Year 1	2	3	4	5	6	7	8	9	10
OPERATING COSTS:										
Support services:										
$, in millions	1.355	1.450	1.664	1.873	2.285	2.670	3.492	3.764	4.403	4.700
% of total	23.83	24.13	25.61	27.19	29.16	30.86	35.28	34.67	35.53	37.54
$/mil gal	34.51	36.82	38.57	41.27	42.76	47.29	61.75	62.02	78.63	74.57
Acquisition:										
$, in millions	.524	.538	.597	.515	.495	.501	.578	.533	.756	.688
% of total	9.22	8.95	9.20	7.48	6.32	5.79	5.83	4.91	6.10	5.49
$/mil gal	13.35	13.65	13.85	11.35	9.26	8.87	10.21	8.79	13.50	10.92
Treatment:										
$, in millions	1.377	1.449	1.448	1.510	1.759	1.902	2.206	2.307	2.573	2.788
% of total	24.23	24.09	22.29	21.92	22.44	21.97	22.27	21.24	20.76	22.25
$/mil gal	35.07	36.76	33.57	33.27	32.90	33.67	39.01	38.01	45.95	44.24
Power and pumping:										
$, in millions	.999	1.003	1.094	1.143	1.336	1.404	1.521	1.781	1.908	1.806
% of total	17.57	16.69	16.84	16.59	17.04	16.22	15.36	16.40	15.40	14.41
$/mil gal	25.44	25.46	25.36	25.19	24.98	24.86	26.89	29.34	34.07	28.66
Transmission and distribution:										
$, in millions	1.431	1.572	1.692	1.847	1.963	2.179	2.104	2.473	2.751	2.545
% of total	25.16	26.15	26.05	26.81	25.04	25.17	21.24	22.77	22.20	20.32
$/mil gal	36.43	39.90	39.24	40.70	36.71	38.57	37.20	40.73	49.13	40.37
Total operating costs:										
$, in millions	5.686	6.012	6.496	6.887	7.838	8.656	9.901	10.859	12.390	12.528
$/mil gal	144.80	152.59	150.29	151.78	146.61	153.26	175.06	178.89	221.28	198.76

TABLE 10 (Continued). SUMMARY OF OPERATING AND CAPITAL EXPENDITURES FOR 1965-74 FOR DALLAS WATER UTILITY

Item	Year 1	2	3	4	5	6	7	8	9	10
CAPITAL COSTS:										
Depreciation ($, in millions)	2.979	3.176	3.339	3.494	3.688	3.815	3.986	4.407	4.752	5.135
Interest ($, in millions)	1.918	1.951	2.088	2.246	2.196	2.804	2.193	2.509	3.425	3.638
Total capital costs ($, in millions)	4.397	5.127	5.427	5.740	5.884	5.899	6.179	6.916	8.176	8.773
TOTAL OPERATING AND CAPITAL COSTS:										
$, in millions	10.583	11.140	11.924	12.627	13.722	14.555	16.079	17.775	20.567	21.301
$/mil gal	269.46	282.70	276.42	278.30	256.72	257.72	284.31	292.83	367.29	337.94

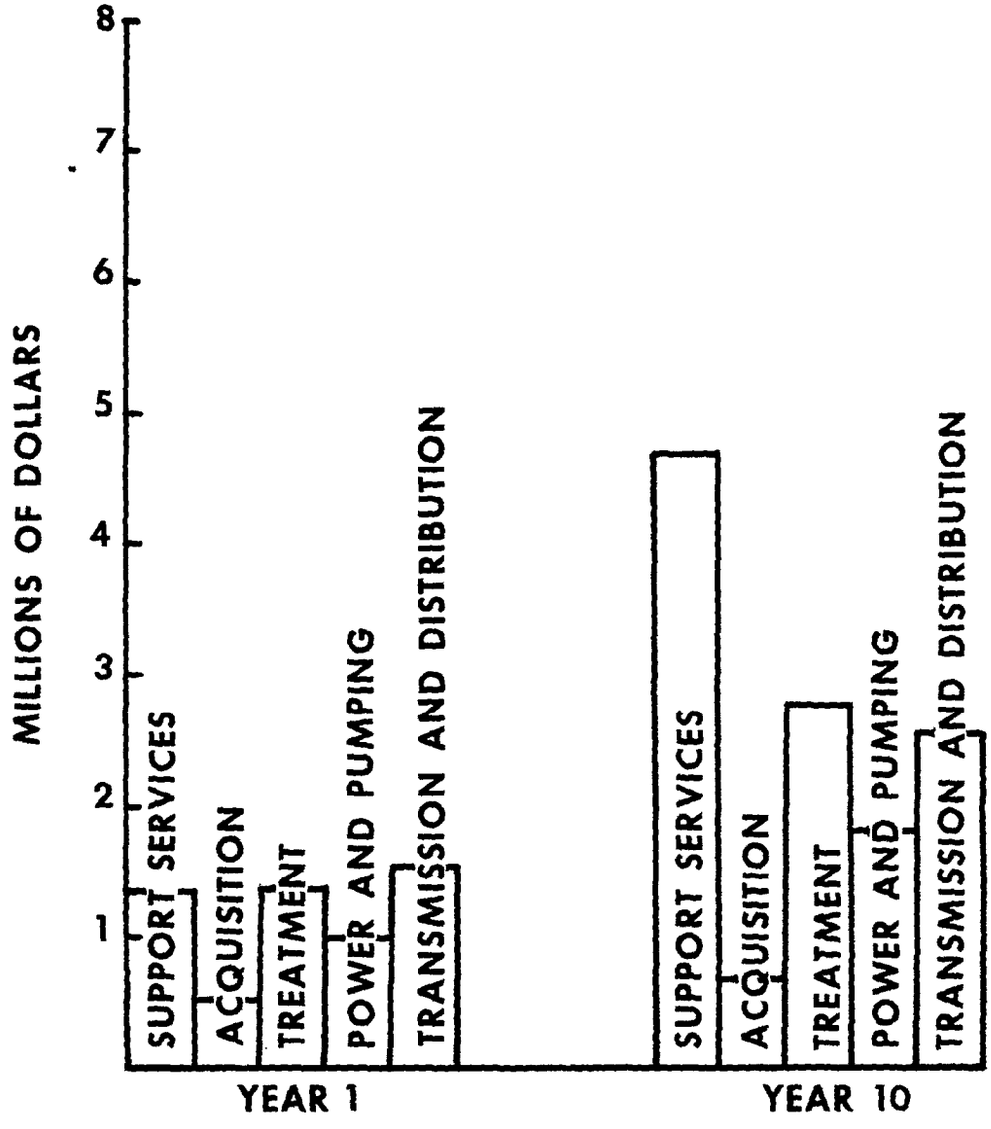


FIG. 27 OPERATING COSTS FOR DALLAS WATER UTILITY

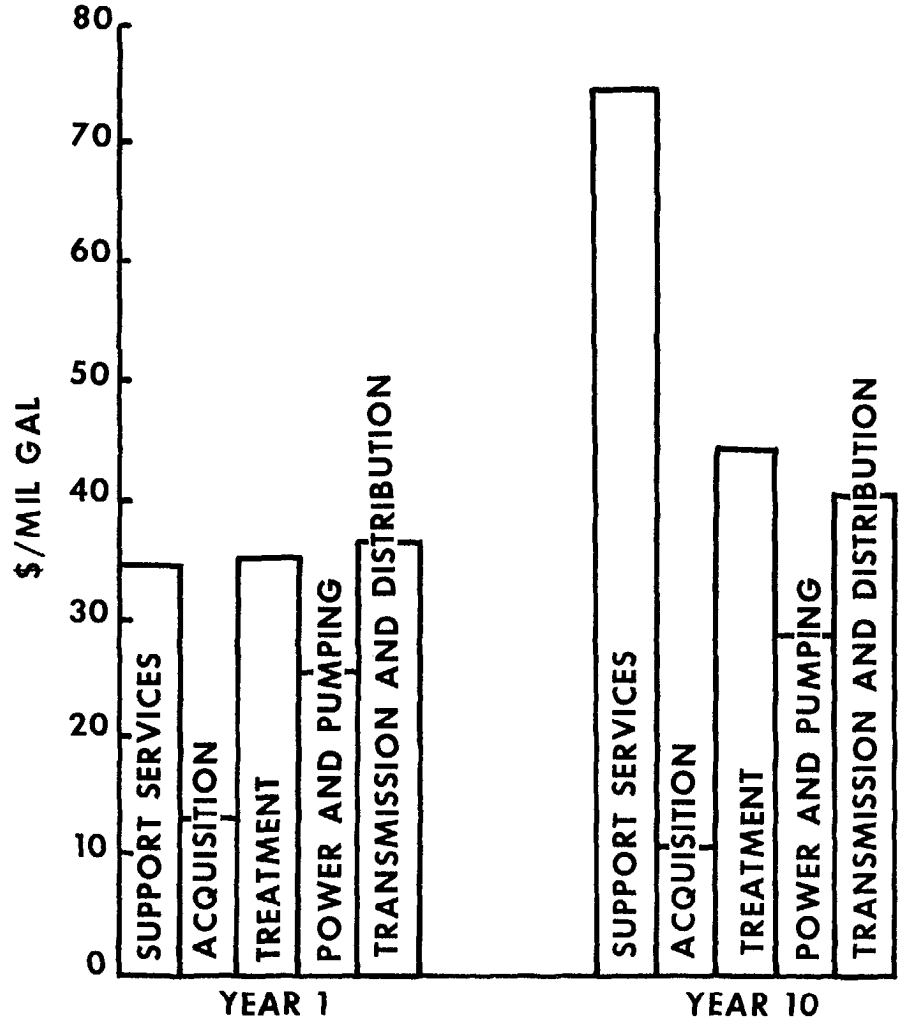


FIG. 28 OPERATING COSTS IN $/MIL GAL FOR DALLAS WATER UTILITY

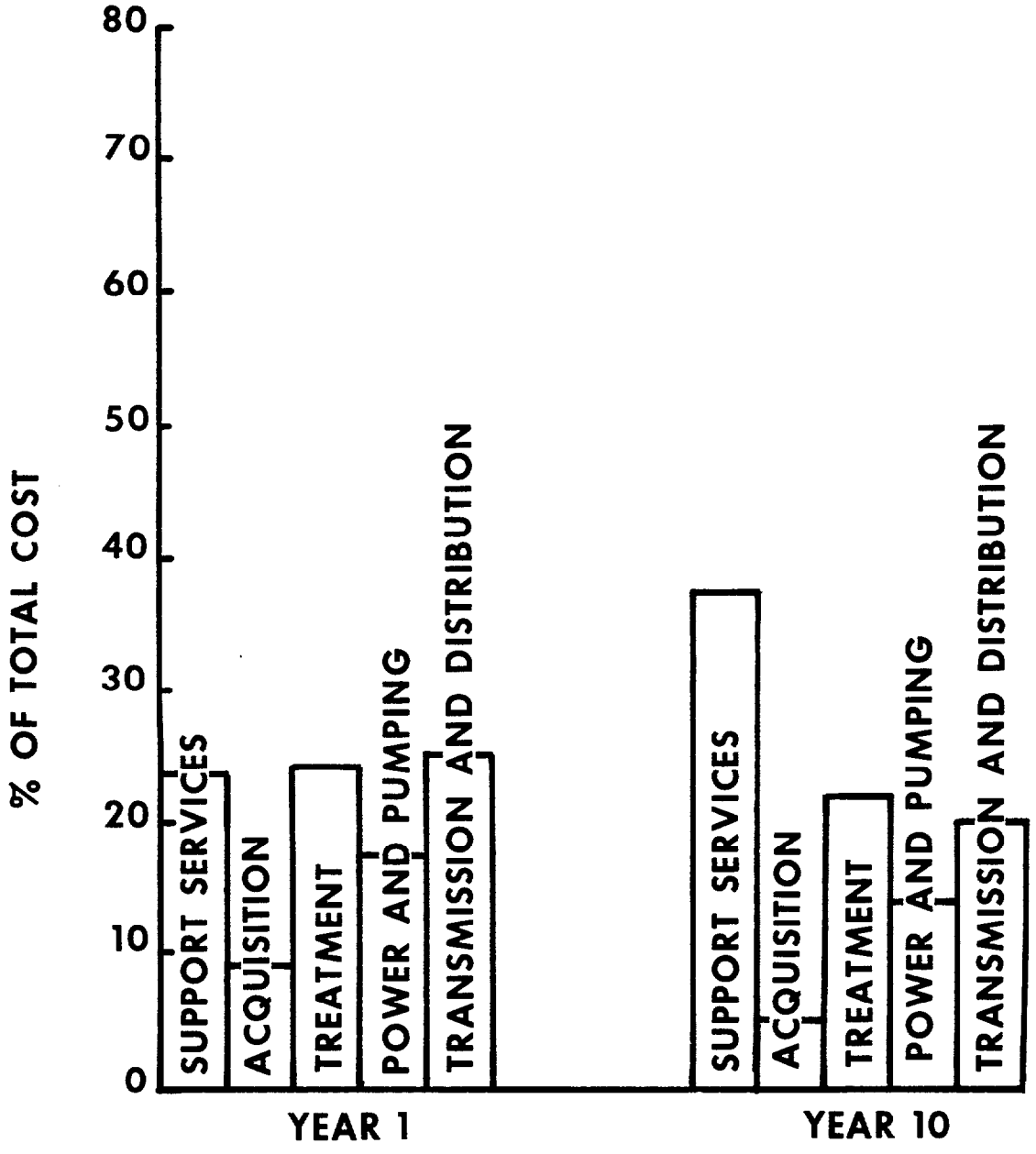


FIG. 29 OPERATING COST AS PERCENT OF TOTAL COST FOR DALLAS WATER UTILITY

conditions, such as excessive rain, the water consumption will be reduced without a corresponding reduction in operating cost. This principle was illustrated in the latest study year when the water consumption significantly decreased and caused an increase in unit operating costs.

The total cost for support services has significantly increased. Table 10 shows that the proportion of the total operating cost devoted to support services increased from 24% in 1964 to 38% in 1973. Cost in each year must total 100%, therefore this increase in the support services category must reflect a decrease in some of the other operating cost categories. For acquisition, which is primarily associated with the operation of reservoirs, the cost as a percent of total cost decreased from 9.2% to 5.4%.

To determine the total cost of producing water, it is necessary to calculate capital expenditures. As discussed earlier in this report, the method chosen is to depreciate the net plant in service, based on original purchase price, on a straight line basis, over the estimated life of the facility. The cost of borrowing money is considered to be the actual interest paid by the utility when money is borrowed.

For the purpose of this report, the total cost of producing water is considered to be operating expenses plus depreciation of capital equipment and facilities, plus the interest paid on borrowed money. The total cost in Dallas for producing water increased from approximately $10.5 million in year 1 to approximately $21.3 million in year 10 -- an increase of 102% in total expenditures (Figure 30). During that same time period, however, the cost of producing a mil gal of water increased only 25%. Table 10 shows that in the latest year of record, the Dallas Water Utility expended $337.94 for each million gallons sold that year.

As with the Kansas City and Cincinnati water supplies, the capital costs, operating costs, and total expenditures over time are illustrated (Figures 31 through 33). Unit costs have decreased on a corrected basis using the Consumer Price Index with 1965 as the base year.

System Evaluation

Figure 25 shows the locations of treatment facilities in the Dallas service area. Because the facilities ring the service area, relating cost to distance is difficult. Figure 34 is a schematic diagram of the Dallas treatment facilities and the capital and operating expenses they incur. Costs assigned to the facilities and to the other cost categories that make up the total cost for each service zone are shown in Table 11. Figure 35 illustrates the cost increases that are incurred from the East Fork treatment plant to the Cosa Crest service area. This is simply another illustration of the way in which costs can be seen to vary with distance from the treatment plant.

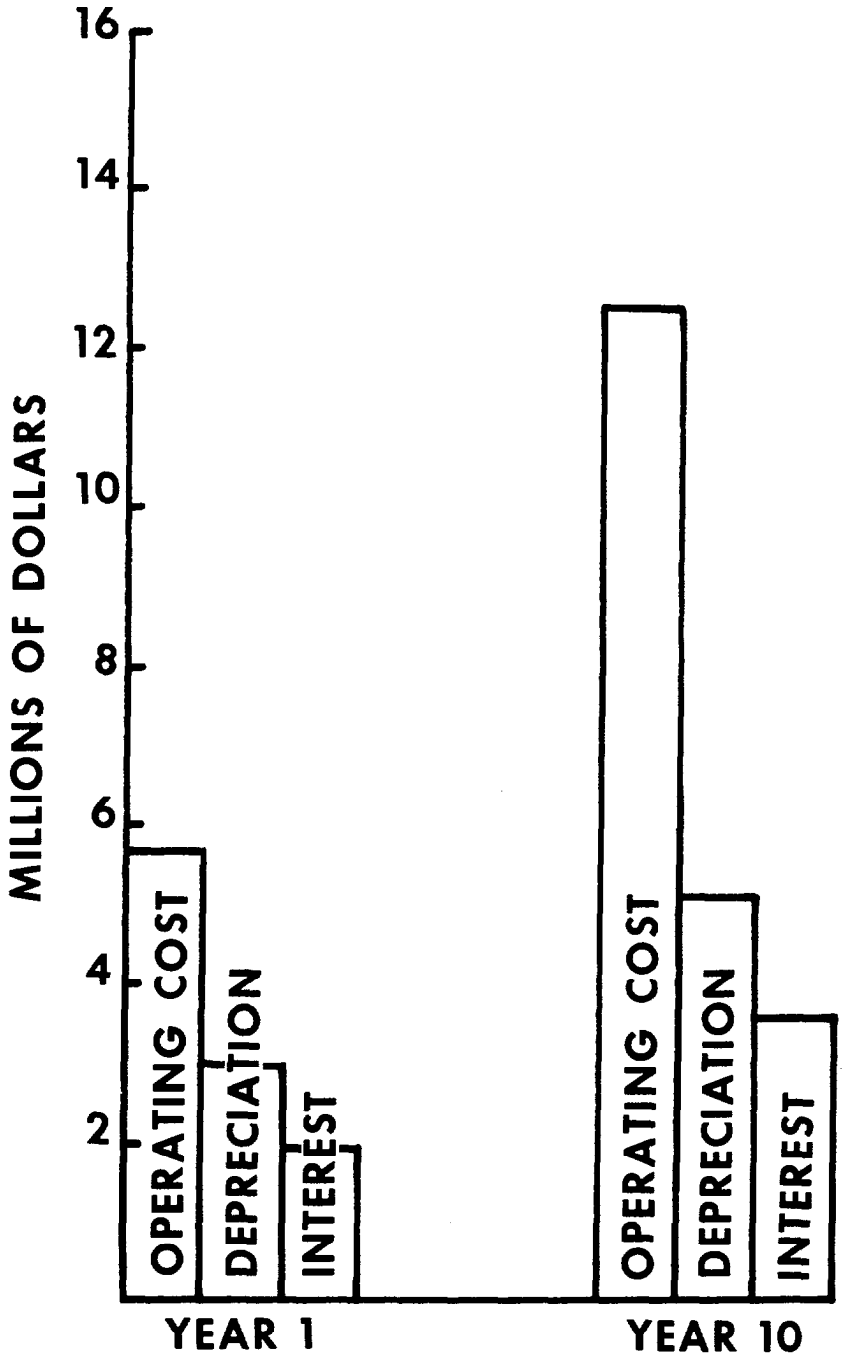


FIG. 30 OPERATING AND CAPITAL COSTS FOR DALLAS WATER UTILITY

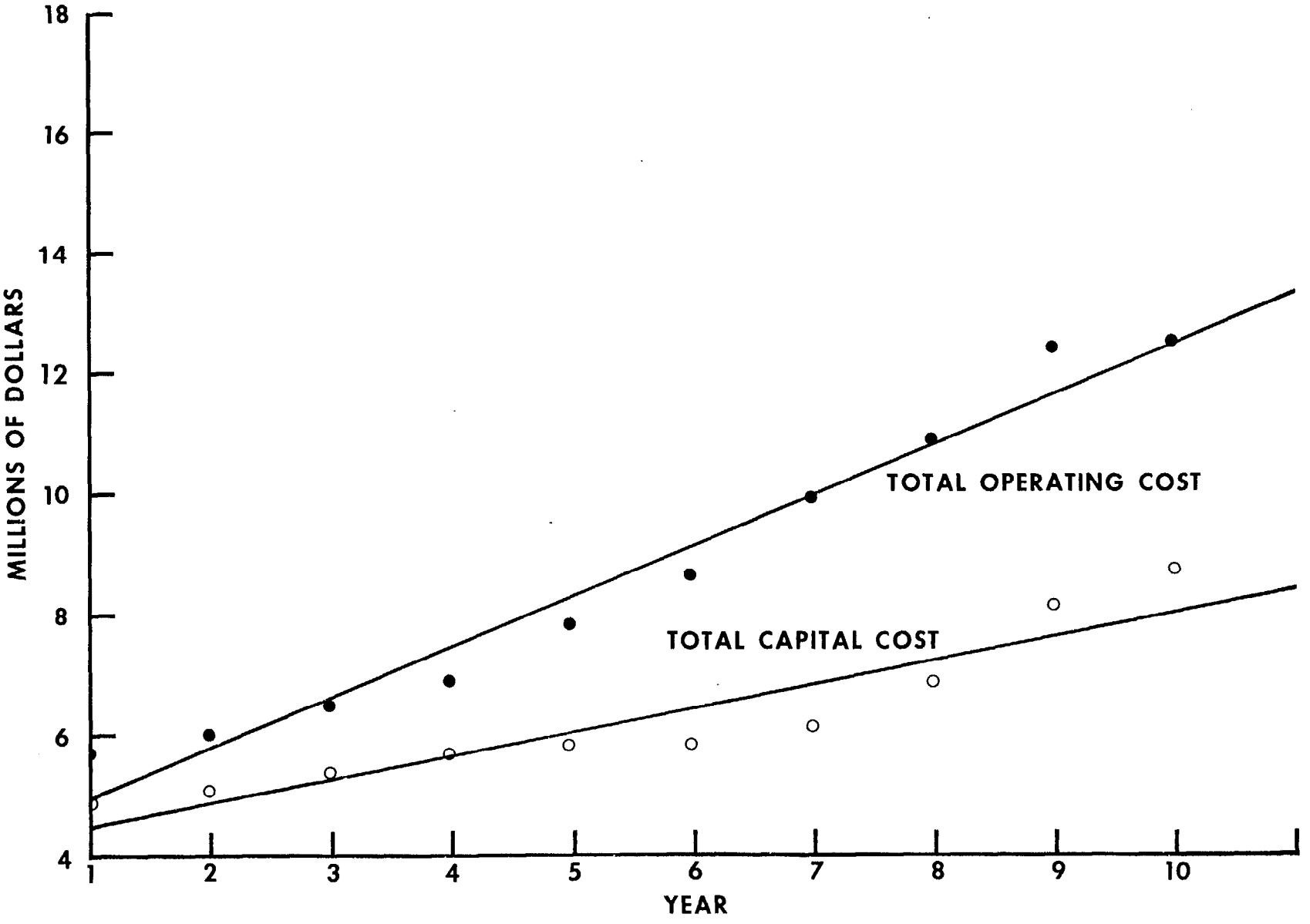


FIG. 31 OPERATING AND CAPITAL EXPENDITURES FOR DALLAS WATER UTILITY

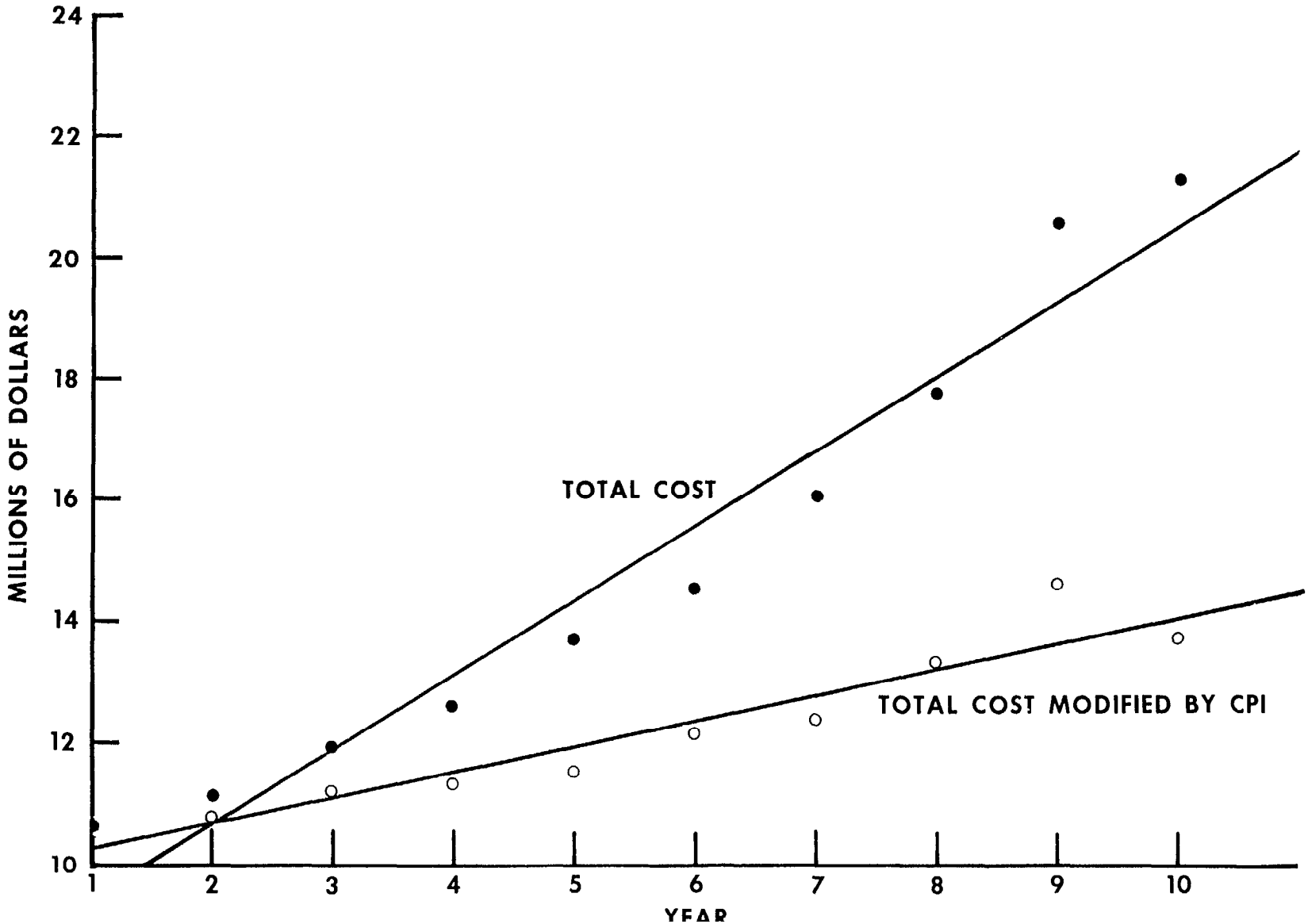


FIG. 32 TOTAL EXPENDITURES FOR DALLAS WATER UTILITY: HISTORICAL AND MODIFIED

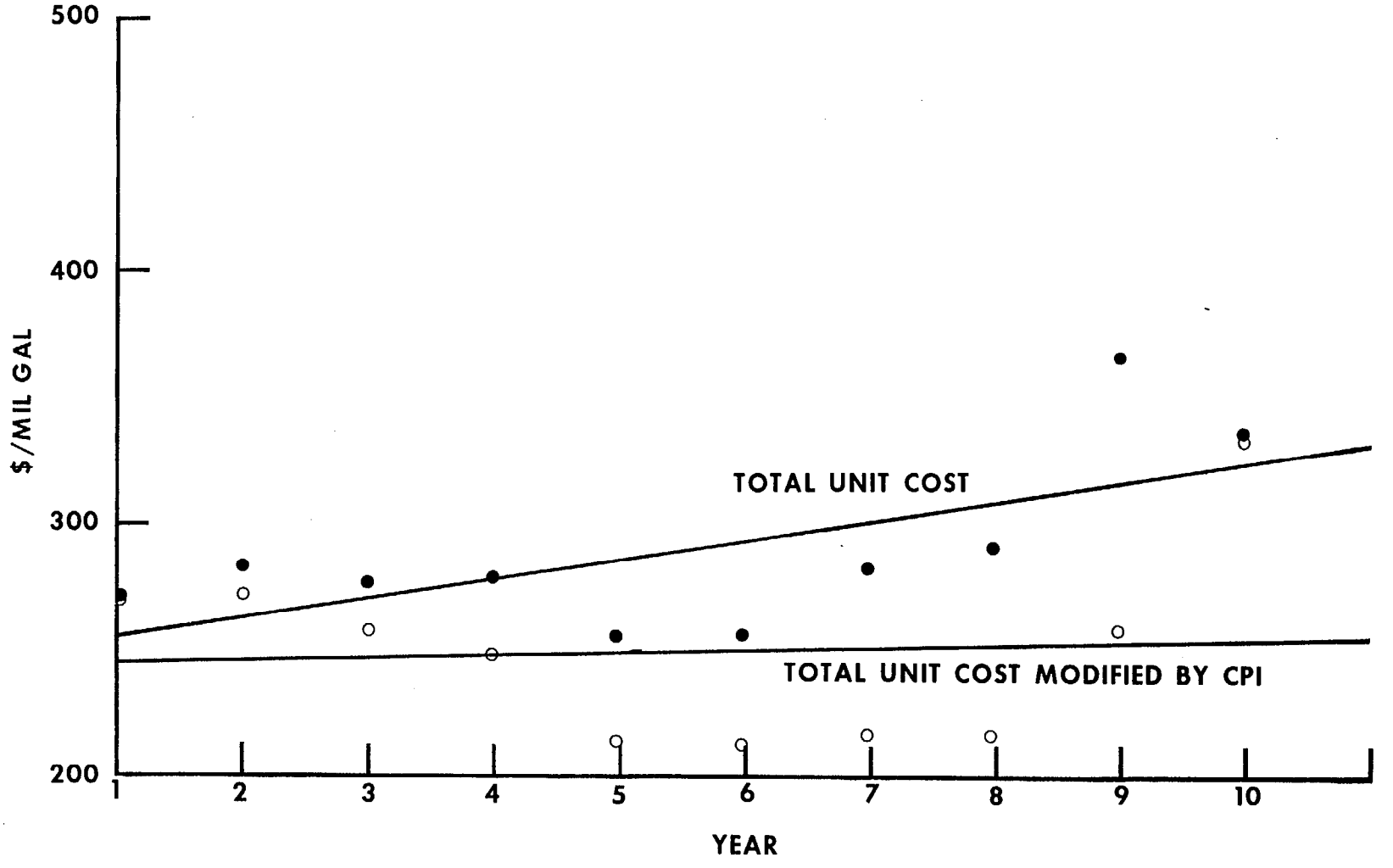


FIG. 33 TOTAL UNIT COSTS FOR DALLAS WATER UTILITY: HISTORICAL AND MODIFIED

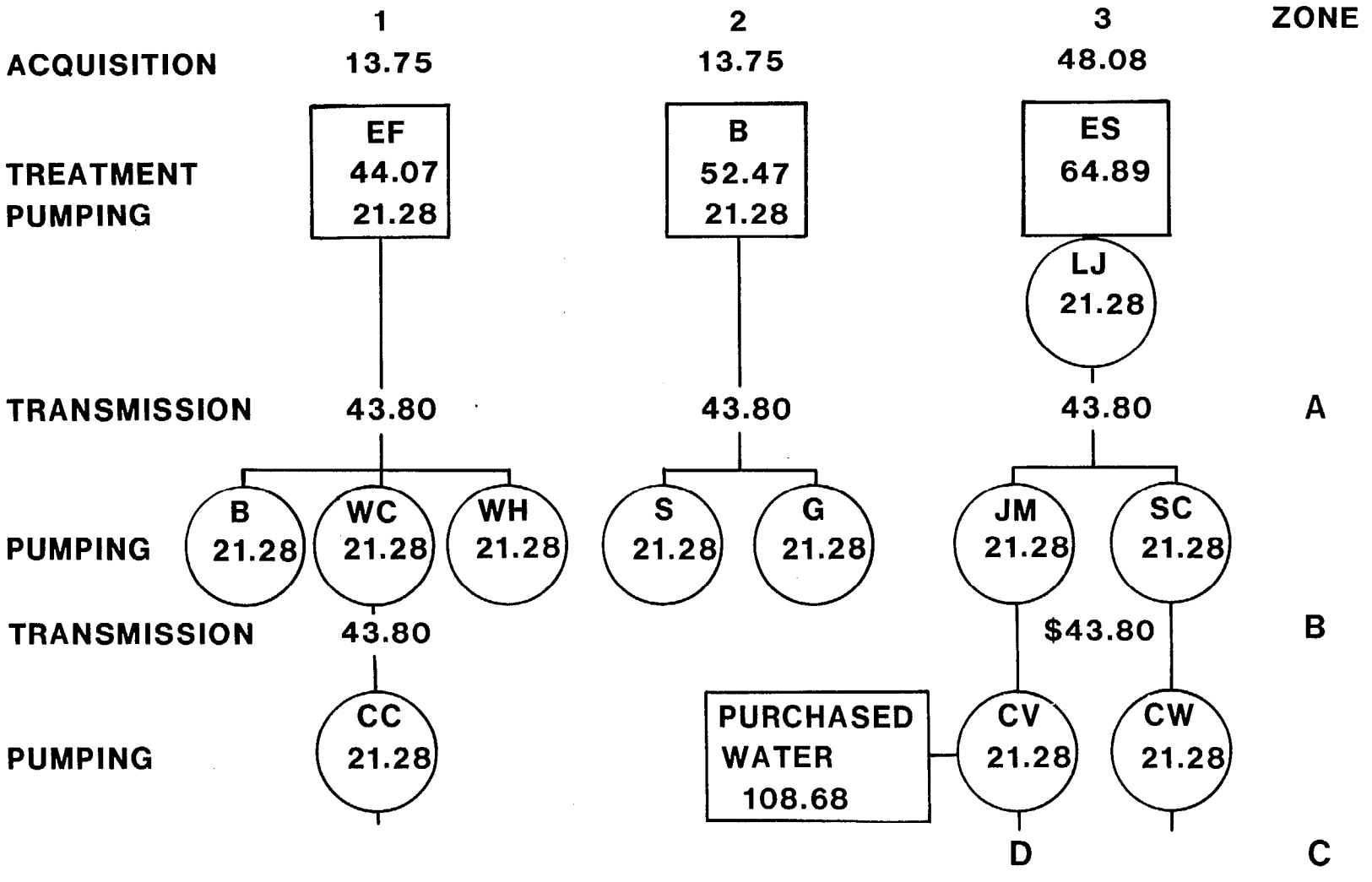


FIG. 34 ALLOCATION OF CAPITAL AND OPERATING EXPENSES TO WATER SYSTEM COMPONENTS FOR DALLAS WATER UTILITY (COSTS IN $/MIL GAL OF REVENUE PRODUCING WATER)

TABLE 11. COST ELEMENTS FOR SERVICE ZONES

Cost zone	Incremental cost ($/mil gal)	Distribution cost ($/mil gal)	Interest cost ($/mil gal)	Overhead cost ($/mil gal)	Total cost ($/mil gal)	Metered consumption (mil gal)	Revenue
1 A	$ 70.90	$ 67.33	$ 57.72	$ 83.46	$279.41	16,766	$ 4,684,588.06
B	132.25	67.33	57.72	83.46	340.76	16,323	5,562,225.48
C	193.60	67.33	57.72	83.46	402.11	334	89.670,.53
2 A	104.66	67.33	57.72	83.46	313.16	872	2,465,274.24
B	166.01	67.33	57.72	83.46	374.52	854	2,566,960.08
3 A	153.04	67.33	57.72	83.46	361.55	4,212	1,522,848.60
B	214.39	67.33	57.72	83.46	422.90	5,936	2,933,234.40
C	275.74	67.33	57.72	83.46	484.25	87	623,299.75
3 D	129.96	67.33	57.72	83.46	333.88	557	853,731.16
					337.96	63,030	21,301,762.30

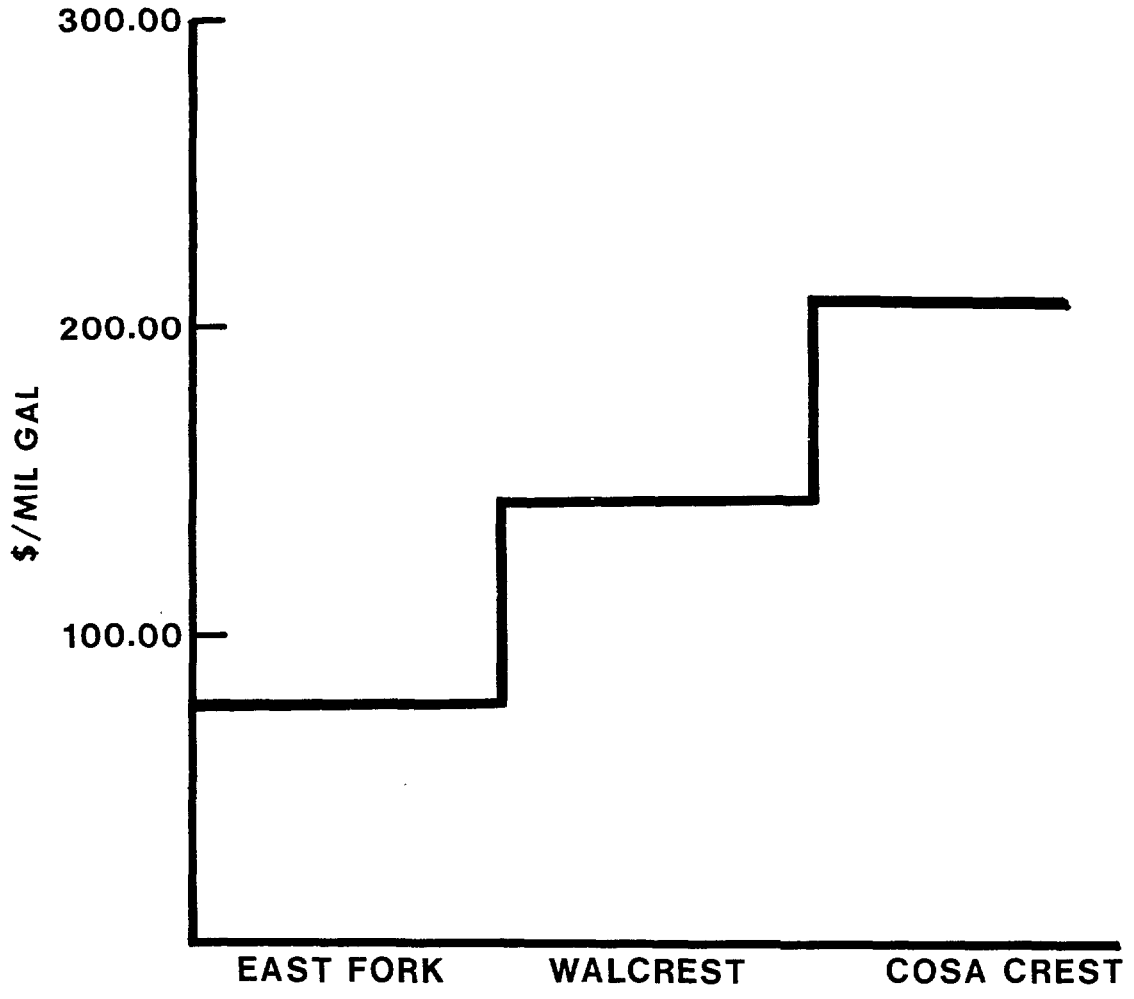


FIG. 35 COST OF SERVICE OVER PATHWAY 1

ELIZABETHTOWN WATER COMPANY

The Elizabethtown Water Company provides water to five counties in New Jersey -- Union, Summerset, Mercer, Middlesex, and Hunterden. The service population, which was 507,836 in the last year of analysis, has remained relatively stable, but water consumption has increased by 30% over the last three years.

This utility is investor-owned and as such has some different characteristics compared to the publicly-owned utilities mentioned earlier. One difference is a liability for real estate tax incurred by the Elizabethtown Water Company but not by public utilities.

Organizationally, the utility is controlled by a board of directors and consists of four organizational entities: operations, controller, business, and legal. The president reports directly to the chairperson of the board.

Raw water comes from both surface and ground sources. Approximately 77% of the source water is from surface water, and 23% is from the ground.

Figure 36 illustrates consumer demand for water over the 10-year period. Treated water is that pumped from wells, treated in one of the four treatment plants, or purchased. Revenue-producing water is that water that is metered and paid for by wholesale and retail customers of the Elizabethtown Water Company.

Cost Evaluation

Operating costs were categorized into acquisition, treatment, transmission and distribution, power and pumping, and support services. Table 12 summarizes historic costs for 10 years.

Operating costs were divided by millions of gallons of revenue-producing water to provide unit operating costs. The patterns of expenditure are similar to those of other utilities discussed. Table 12 shows that the utility's tax burden is significant. Taxes have increased from $2.646 million in 1965 to $3.935 million in 1974.

Figures 37 through 40 show the changes that have occurred in operating costs with respect to total cost, unit cost, percentage of total cost, and changes in O&M and capital cost. Total operating and capital costs over time, corrected by the CPI assuming 1965 as the base year are shown in Figures 41 through 43.

System Evaluation

The water distribution and treatment system for the Elizabethtown Water Company is complex because of the different acquisition points for water supply. Volume II contains a detailed evaluation of the system.

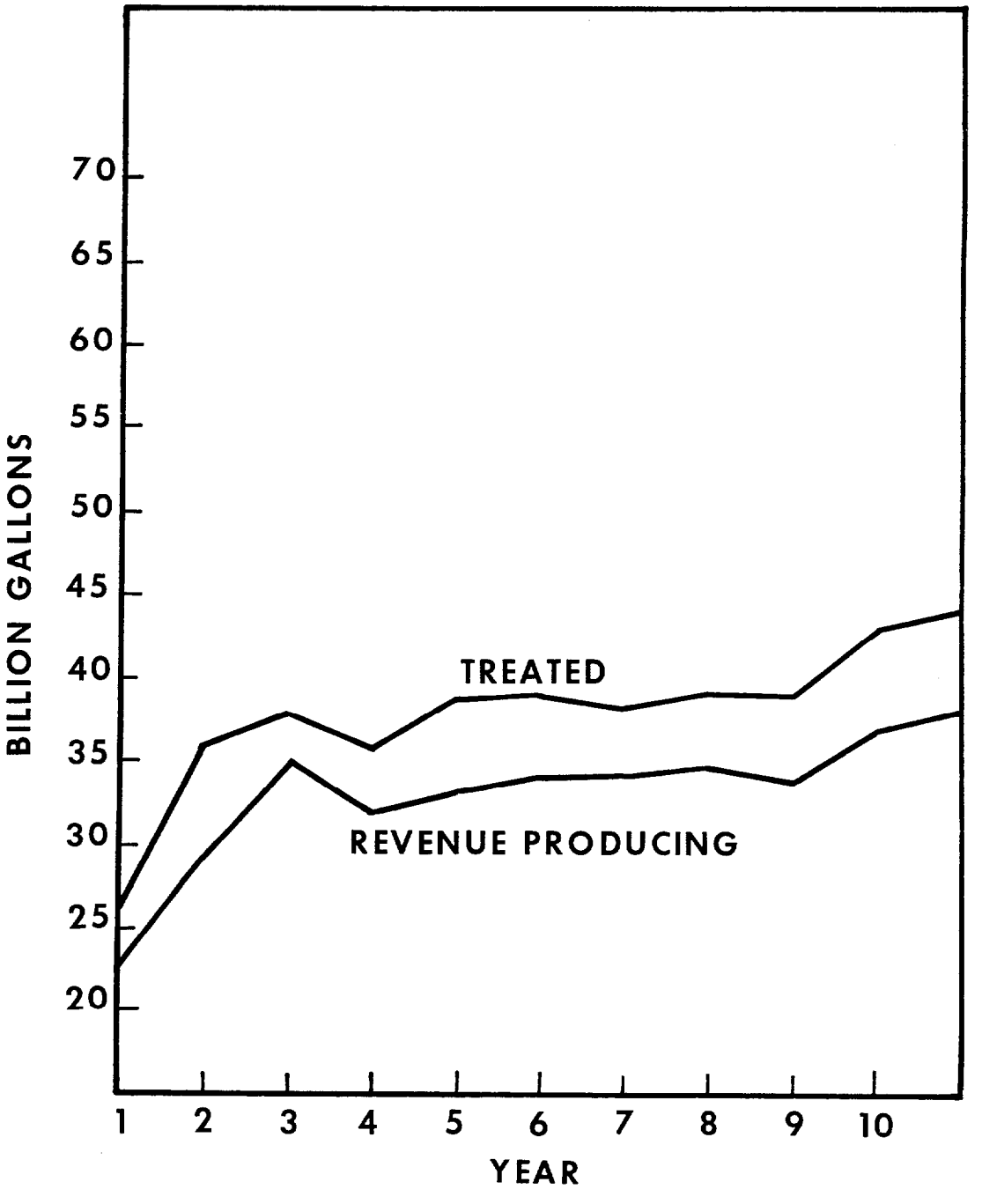


FIG.36 TREATED AND REVENUE PRODUCING WATER FOR ELIZABETHTOWN WATER COMPANY

TABLE 12. SUMMARY OF OPERATING AND CAPITAL EXPENDITURES FOR ELIZABETHTOWN WATER UTILITY

Item	Year 1	2	3	4	5	6	7	8	9	10
OPERATING COSTS:										
Support Services:										
$, in millions	1.192	1.305	1.392	1.449	1.766	2.108	2.277	2.351	2.677	3.028
% of total	32.15	30.07	30.74	30.08	32.24	35.57	34.39	33.59	34.18	31.38
$/mil gal	40.61	37.77	43.89	45.11	52.17	61.26	65.38	68.57	73.19	79.18
Acquisition:										
$, in millions	0.485	0.748	0.979	1.048	1.093	1.175	1.226	1.492	1.478	1.502
% of total	13.08	17.23	21.63	21.05	19.94	19.83	18.52	21.32	18.88	15.56
$/mil gal	16.52	21.64	30.88	31.55	32.27	34.15	35.21	43.52	40.42	39.28
Power and Pumping:										
$, in millions	0.964	1.079	1.043	1.104	1.161	1.132	1.408	1.412	1.818	2.710
% of total	26.00	24.86	23.02	22.16	21.20	19.09	21.28	20.18	23.21	28.09
$/mil gal	32.85	31.23	32.87	33.23	34.30	32.89	40.44	41.19	49.73	70.89
Transmission and Distribution:										
$, in millions	0.619	0.644	0.703	0.813	0.879	0.918	1.017	1.020	1.069	1.294
% of total	16.70	14.83	15.51	16.31	16.04	15.49	15.37	14.56	13.65	13.41
$/mil gal	21.09	18.63	22.15	24.46	25.96	26.68	29.21	29.73	29.23	33.84
Treatment:										
$, in millions	0.448	0.565	0.412	0.519	0.579	0.593	0.691	0.725	0.790	1.116
% of total	12.07	13.01	09.10	10.40	10.58	10.02	10.44	10.35	10.08	11.56
$/mil gal	15.25	16.34	13.00	15.60	17.11	17.25	19.85	21.14	21.59	29.18
Total Operating Costs:										
$, in millions	3.707	4.341	4.529	4.983	5.479	5.927	6.619	7.001	7.832	9.649
$/mil gal	126.32	125.61	142.79	149.95	161.81	172.23	190.09	204.15	214.16	252.37

TABLE 12 (Continued). SUMMARY OF OPERATING AND CAPITAL EXPENDITURES FOR ELIZABETHTOWN WATER UTILITY

Item	Year 1	2	3	4	5	6	7	8	9	10
CAPITAL COSTS:										
Depreciation:										
($, in millions)	0.915	1.004	1.079	1.145	1.200	1.297	1.352	1.418	1.521	1.693
Interest:										
($, in millions)	1.039	1.345	1.577	1.872	2.508	2.927	2.819	2.908	3.373	4.327
Total capital cost:										
($, in millions)	1.954	2.349	2.656	3.017	3.708	4.224	4.171	4.326	4.894	6.020
Total operating and capital cost:										
$, in millions	5.661	6.690	7.185	8.000	9.187	10.187	10.790	11.327	12.726	15.669
$/mil gal	192.89	193.55	226.58	240.70	271.31	296.05	309.86	330.32	347.97	409.81
Taxes ($, in millions)	2.646	2.658	2.324	2.559	3.561	3.392	3.210	3.030	4.617	3.935
Total Cost:										
$, in millions	8.307	9.348	9.509	10.559	12.748	13.543	14.000	14.357	17.343	19.604
$/mil gal	283.04	270.45	299.86	317.70	376.47	393.58	402.04	418.68	474.22	512.72

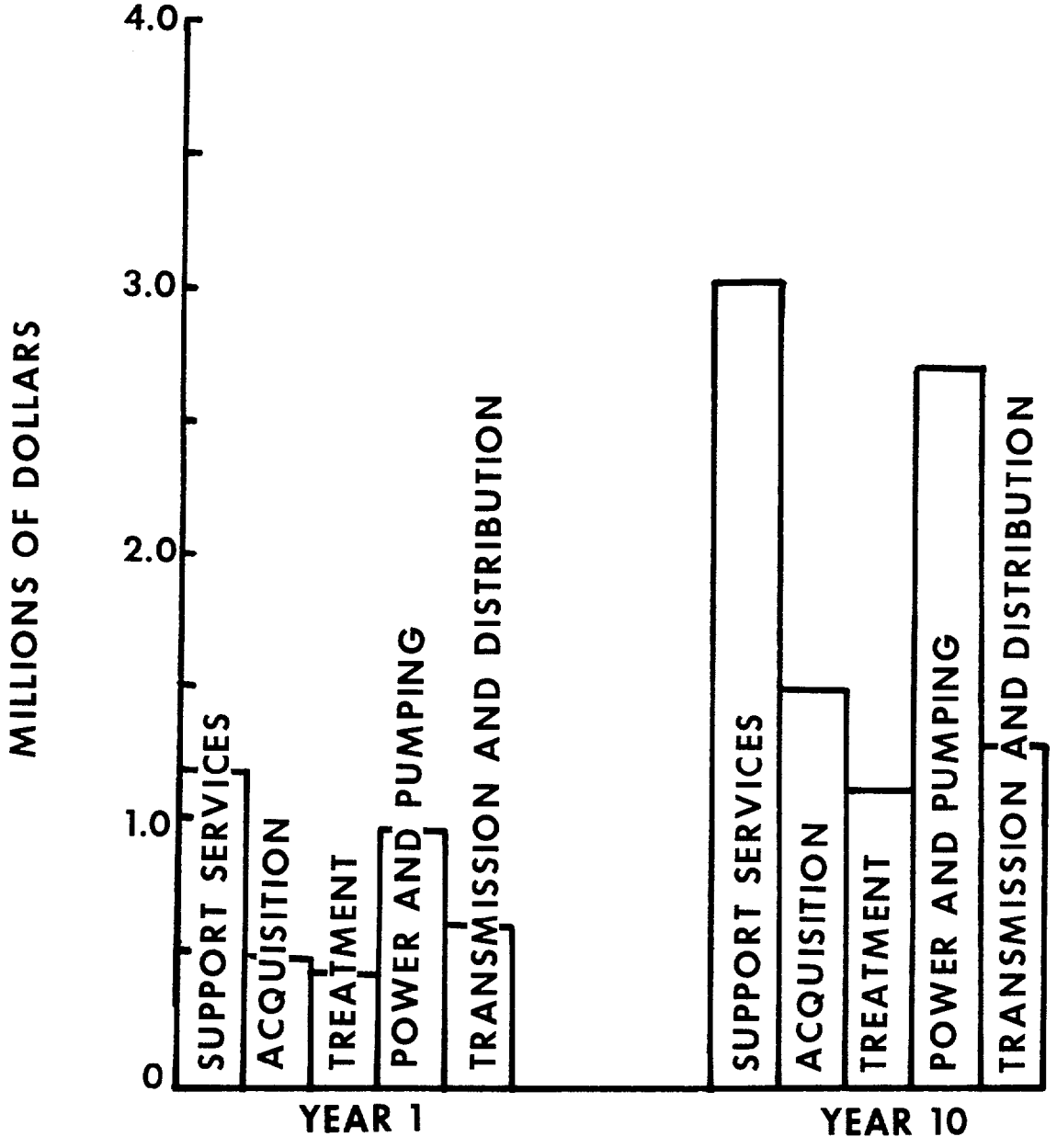


FIG. 37 OPERATING COSTS FOR ELIZABETH-TOWN WATER UTILITY

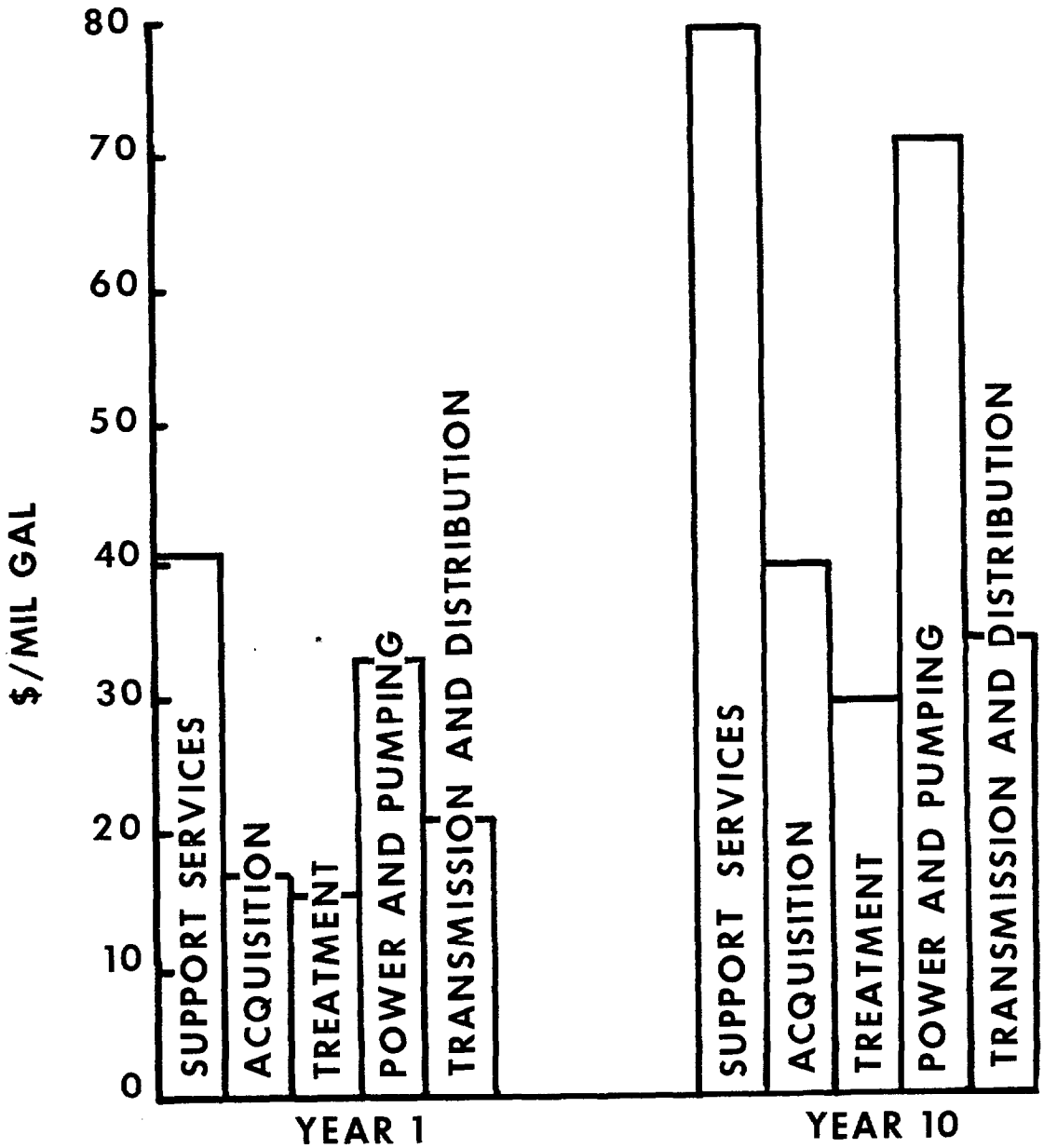


FIG. 38 OPERATING COST IN $/MIL GAL FOR ELIZABETHTOWN WATER UTILITY

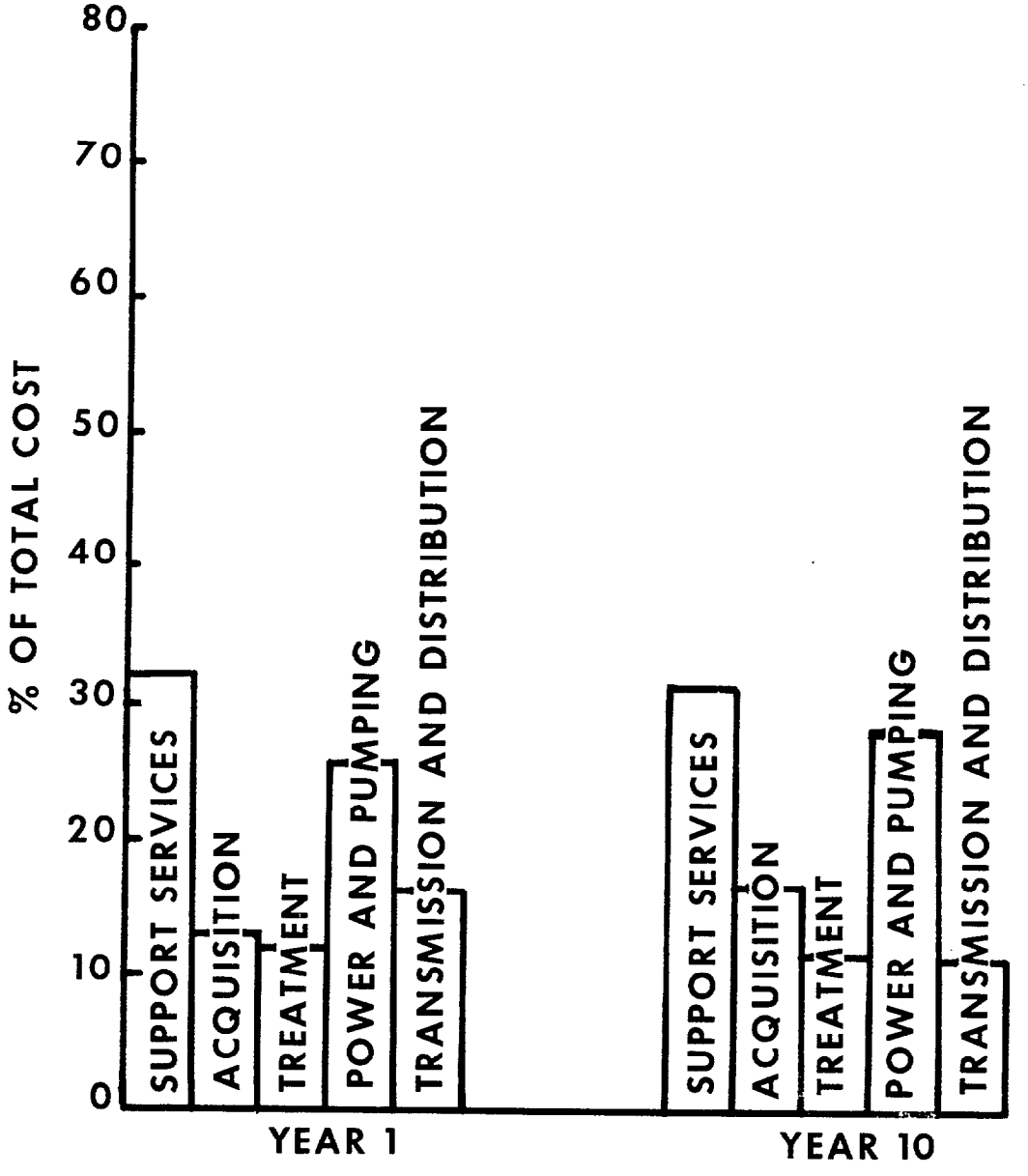


FIGURE 39

FIG. 39 OPERATING COST AS PERCENT OF TOTAL COST FOR ELIZABETHTOWN WATER UTILITY

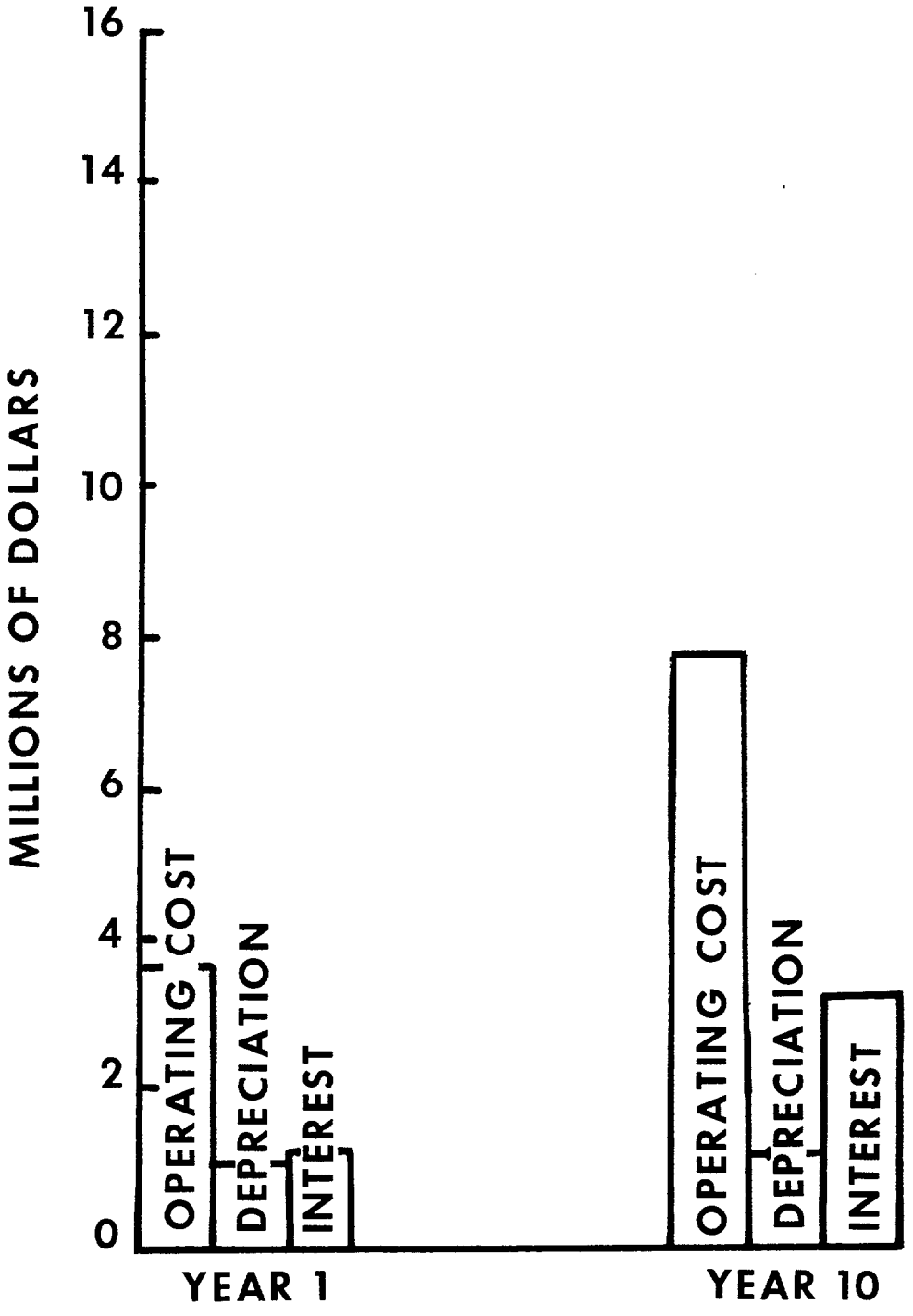


FIG. 40 OPERATING AND CAPITAL COSTS FOR ELIZABETHTOWN WATER UTILITY

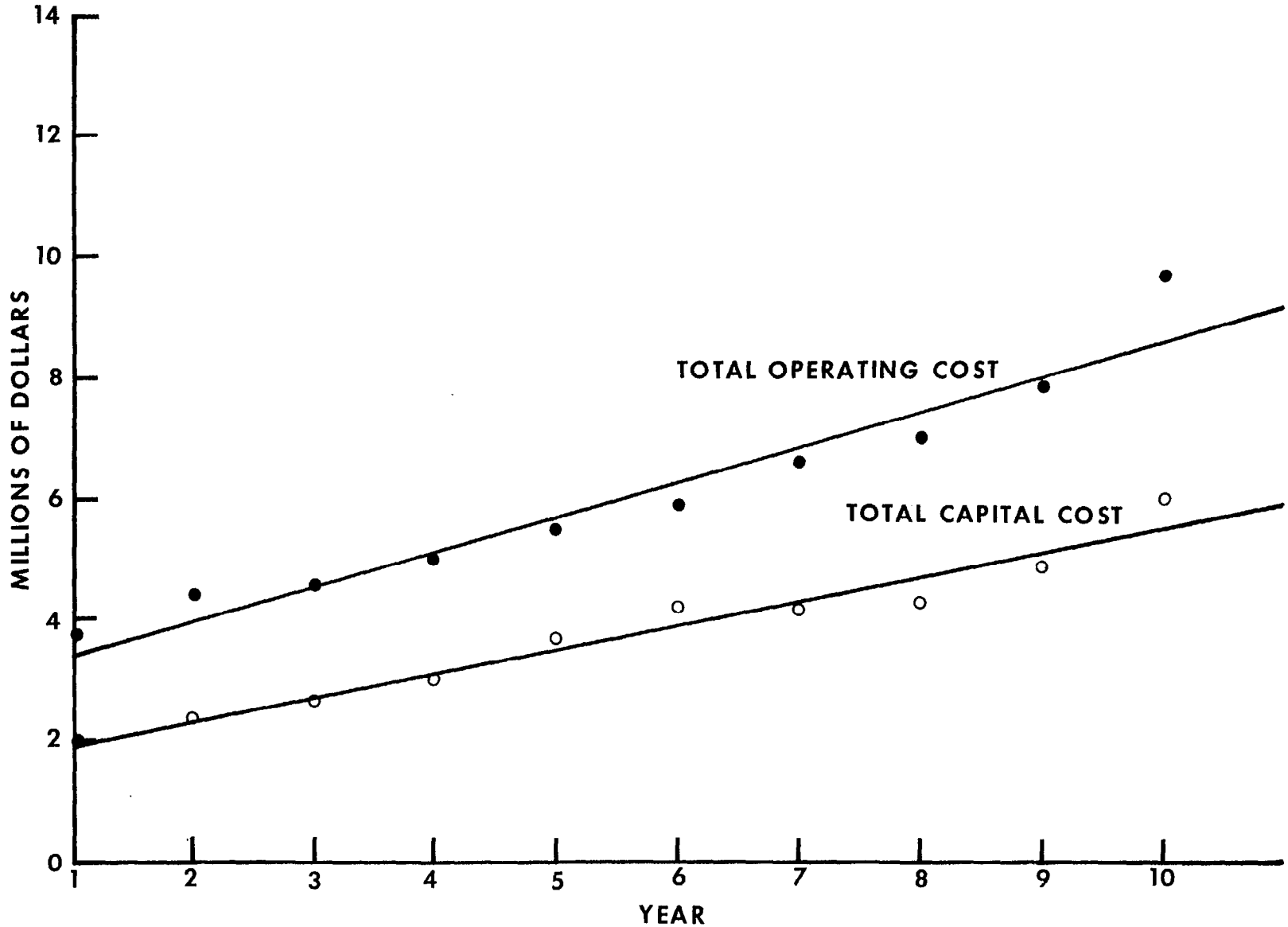


FIG. 41 OPERATING AND CAPITAL EXPENDITURES FOR ELIZABETHTOWN WATER COMPANY

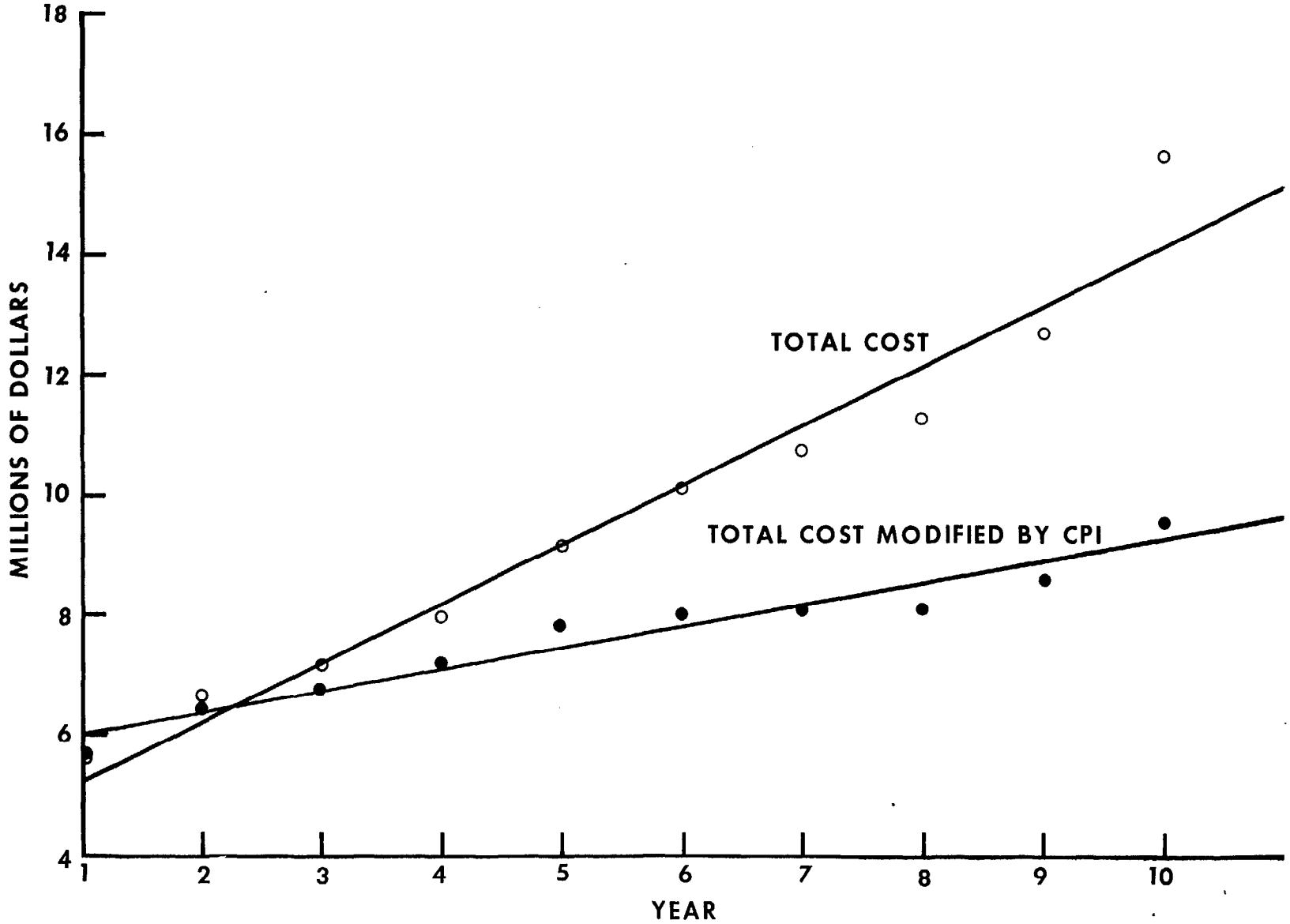


FIG. 42 TOTAL EXPENDITURES FOR ELIZABETHTOWN WATER COMPANY: HISTORICAL AND MODIFIED

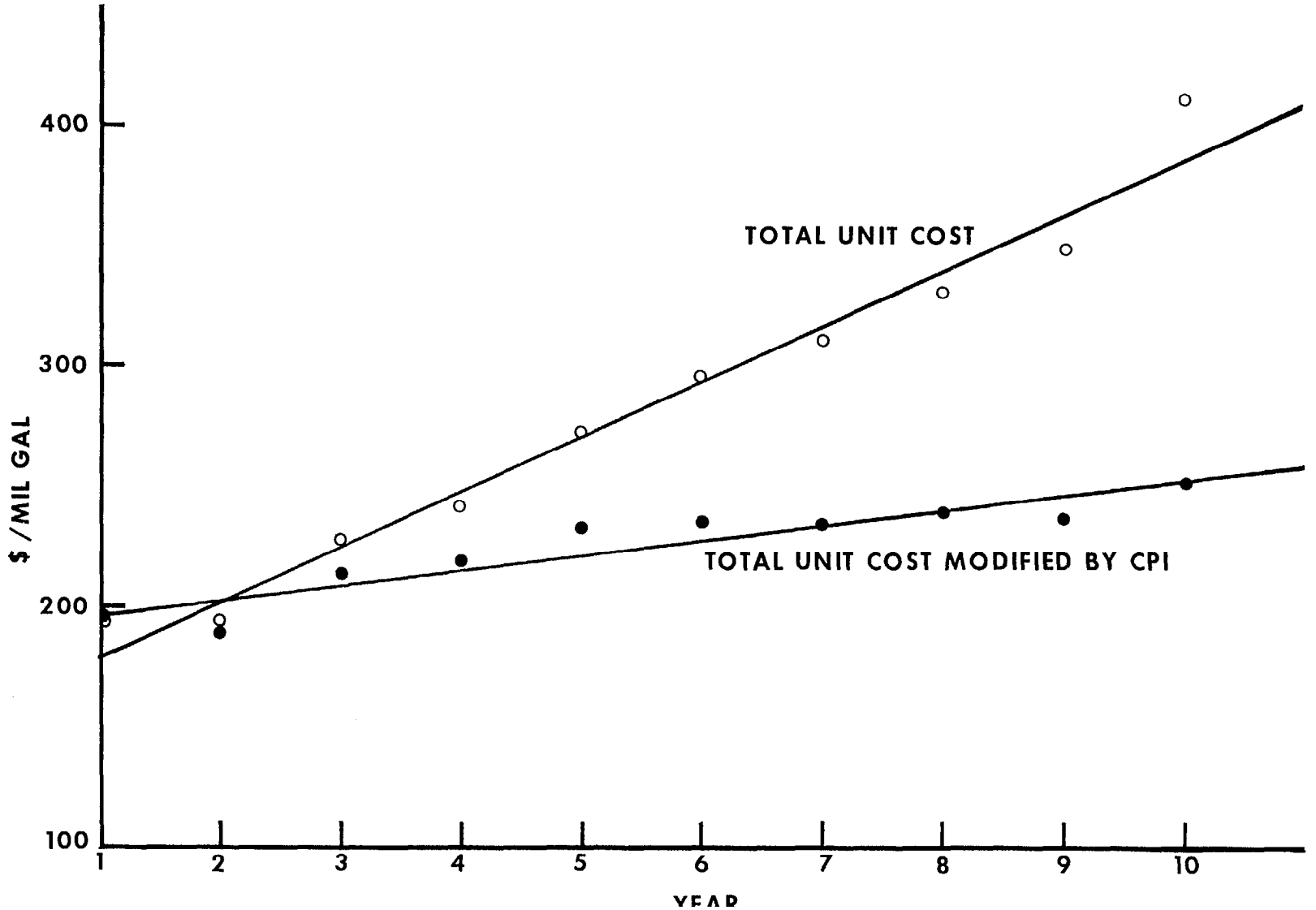


FIG. 43 UNIT COSTS FOR ELIZABETHTOWN WATER COMPANY: HISTORICAL AND CORRECTED

FAIRFAX COUNTY AUTHORITY

The Fairfax County Water Authority, headquartered in Annandale, Virginia, was created under the Virginia Water and Sewage Authority Act of 1950 to supply and distribute water to Fairfax County. The Authority's charter was amended to allow it to provide sewerage services both in and outside of the county, but it cannot levy any taxes or assessments, nor do the obligations of the Authority become obligations of Fairfax County.

Beginning in 1959, the Authority acquired 15 water companies and 22 separate water systems. The Alexandria Water Company, acquired in 1967, serves 70 percent of the Authority's customers -- nearly two-thirds of the population of Fairfax County (364,000), including small areas adjacent to the county. The service area encompasses approximately 400 square miles.

Cost Analysis

Figure 44 illustrates the growth in consumer demand for water over the 10-year period. Rapid growth in billed consumption resulted from the acquisition of new customers. Because accounting problems make it difficult to identify costs according to the functional cost categories mentioned earlier, expenses for the first four years are reported on a total cost basis. From the fifth through the tenth year, costs are identified according to the standardized categories shown in Table 13. Figures 45 through 48 show the changes that have taken place in the operating and capital costs over the period of analysis. Total operating and capital costs over time, corrected by the CPI, are shown in Figures 49 through 51.

Note that unit costs dropped significantly in 1968 with the addition of the Alexandria Water Company to the Authority. This drop in cost reflects some of the economies of scale that may take place when water supplies existing in close proximity band together in a regional water system. The decline in unit prices associated with the addition of Alexander Water Company is due to the averaging into the total cost a system whose operating costs are relatively low due to higher population density.

Systems Analysis

As with the Elizabethtown Water Company, the Fairfax County Water Authority is extremely complex. The system is described in detail in Volume II.

SUMMARY

The five utilities that were selected for analysis are unique, but they illustrate trends or conditions that are typical of many municipal water systems. Kansas City is a classic water system, drawing its water from the river, pumping it through one treatment plant, and distributing it to a widespread service area. Because of the system configuration, it is possible to study cost changes as they occur from the treatment plant to the ends of the system. Kansas City is also fairly stable in water production, with very little increase in revenue-producing water over the 10-year period.

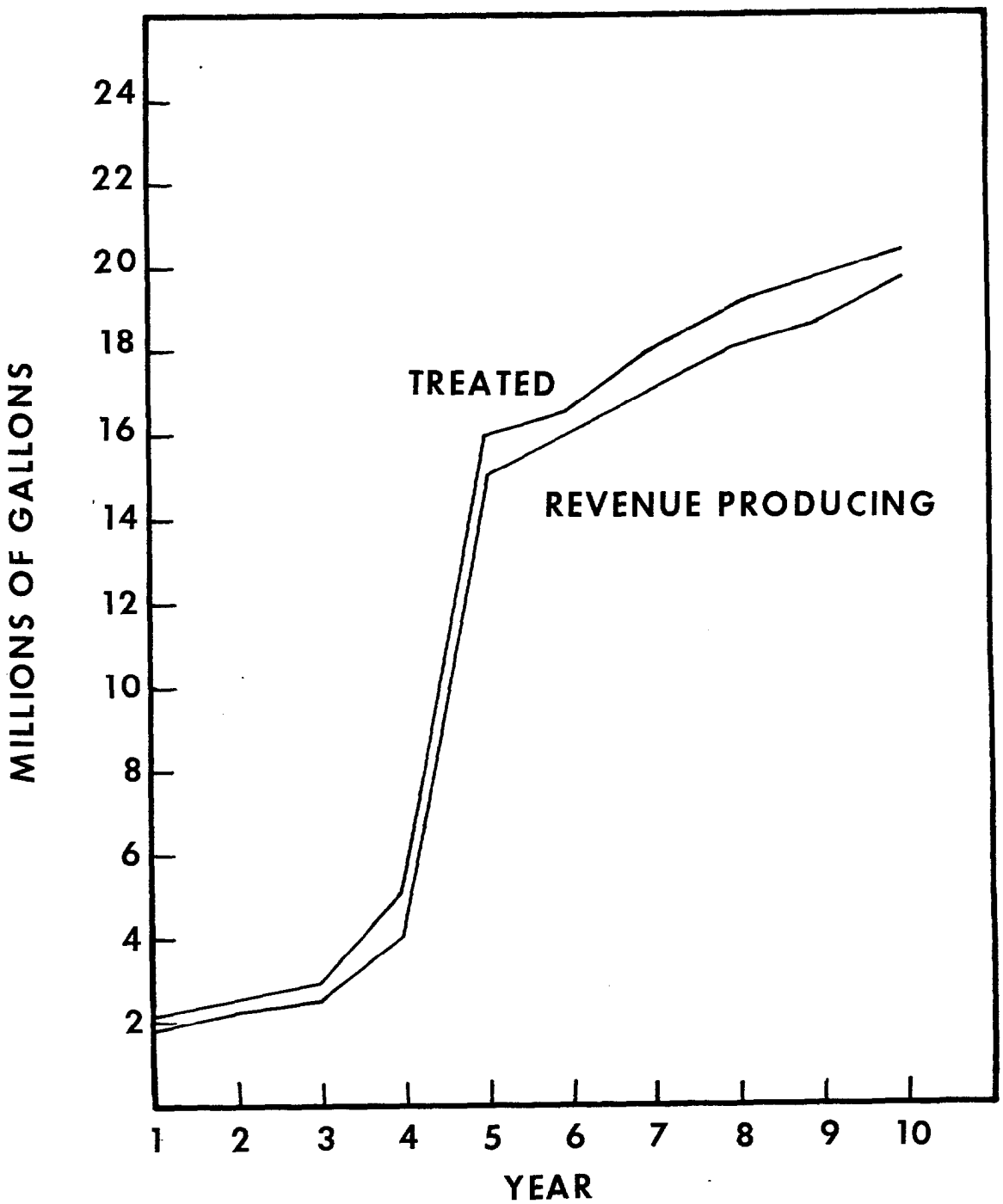


FIG. 44 TREATED AND REVENUE PRODUCING WATER FOR FAIRFAX COUNTY WATER AUTHORITY